1980

Genetic Variance, Heritability and Correlation for Genetic Characters of the Sweet Potato, Ipomoea Batatas, L.

Florencio Ando Saladaga
Louisiana State University and Agricultural & Mechanical College

8110424

SALADAGA, FLORENCIO ANDO

GENETIC VARIANCE, HERITABILITY AND CORRELATION FOR GENETIC CHARACTERS OF THE SWEET POTATO, IPOMOEA BATATAS, L.

The Louisiana State University and Agricultural and Mechanical Col. PH.D. 1980

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106

GENETIC VARIANCE, HERITABILITY AND CORRELATION FOR GENETIC CHARACTERS OF THE SWEET POTATO, *IPOMOEA BATATAS*, L.

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Horticulture

by
Florencio Ando Saladaga
B.S.A., University of the Philippines at Los Baños, 1969
M.S., University of the Philippines at Los Baños, 1973
December, 1980

ACKNOWLEDGMENTS

In working to complete this dissertation, I was indebted to many persons and institutions. Foremost is my indebtedness to Dr. Teme P. Hernandez who provided the direction, guidance, encouragement and support throughout all the stages of this work. I wish to express my heartfelt thanks and appreciation to him. My thanks are also due to the following: the International Development Research Centre (IDRC), Ottawa, Canada for the financial support, i.e. school fees and living and dissertation allowances; the Philippine Government through VISCA President, Dr. Fernando A. Bernardo for assigning me on special detail to pursue this study; Dr. Donald W. Newsom and the Department of Horticulture for the facilities made available in this study; Dr. Harrell H. Hammett for allowing me the research training at the Sweet Potato Research Center, Chase, Louisiana; Dr. Roysell J. Constantin, Dr. Merlin T. Henderson, and Dr. James F. Fontenot for the suggestions, corrections and criticisms; Dr. Kenneth L. Koonce and Mr. Goh Young Soon for assistance in the statistical aspect of this study; Joel Hebert, Robert Souvestre, and Timothy Raiford for all their assistance in the field experiments; Gloria Davis, Sandy Sklar and Marian Pyle for their assistance in the dry matter and baking tests; Karla Hathorne for typing and helping put together this manuscript; and all other staff and workers of the Department of Horticulture and at LSU who have in many ways directly and indirectly helped me.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table		Page

Table | Page

LIST OF FIGURES

ABSTRACT

Polycross progeny tests and comparisons of advanced seedlings (cultivars) were conducted in 1978 and 1979 to determine the genetic variance, heritability and correlations of several characters in the sweet potato, *Ipomoea batatas*, L.

In 1978, 41.8% of the 'LO-323' polycross seedling progeny had copper or rose skin colors and 2.4% had root yields higher than the highest yielding parent plants.

In the 1979 polycross progeny test, estimates of heritability for root skin and flesh color were both very low. Root skin color was positively correlated with yield of US #1 roots, total yield of fleshy roots, vine length, and vine diameter but it was negatively correlated with vine color. Root flesh color was positively correlated with internode length and it was negatively correlated with yield of US #1 roots, total yield of fleshy roots, plant production, vine diameter, and number of branches. The estimates of heritability for yield of US #1 roots and total fleshy roots indicated that selection could be practiced on an individual plant basis. Both the yield of US #1 and total fleshy roots were positively correlated with vine length, vine diameter, internode length, and number of branches. Total fleshy root yield was positively correlated with leaf shape while yield of US #1 roots was negatively correlated with vine color and leaf vein color.

Progeny mean for weight loss in storage was lowest for 'L9-163'. Its genetic variance component was a negative value and its correlation coefficients with other characters were not significant. For plant production, heritability was very low and it was negatively correlated with root flesh color. Vine length, vine diameter, young foliage color, leaf shape, and petiole length had high estimates of genetic variances with heritability values of over 0.50. Vine color, internode length, number of branches, and leaf vein color had lower than 0.21 heritability values.

Comparisons of advanced seedlings in 1978 showed that 'L4-62' and 'L5-36' had comparable US #1 root yields with 'Centennial' in total marketable roots, 'L0-323' had a comparable yield with 'Centennial'. 'L4-112' produced the highest yield of US #2 or canners grade roots, and it produced the largest number of total marketable roots. In 1979, 'L0-323' and 'L4-62' produced the highest yields of US #1 roots, Jumbo roots and total marketable roots. 'L3-186' and 'L4-131' had the highest dry matter content among the advanced seedlings but lower than 'Porto Rico'. 'L5-150' and 'L4-131' had the least weight loss in storage at 60°F (15.5°C) and 'L5-36' had the least weight loss at 70°F (21.1°C). As an average of cultivars, weight loss at 70°F (21.1°C) storage was higher than weight loss at 60°F (15.5°C) storage both in 1978 and 1979 tests.

Organoleptic ratings for baked roots in 1978 showed that 'LO-323', 'L4-112' and 'L4-131' had comparable baking indices at 60°F (15.5°C) and at 70°F (21.1°C). Generally all the cultivars were considered acceptable in quality factors in 1978 and 1979 tests. Dry matter content was positively correlated with flavor of baked roots at both storage temperatures in both 1978 and 1979 tests. Plant production tests in 1978 and 1979 showed that 'Porto Rico' and 'L4-112' produced the largest number of plants per bushel of roots stored at 60°F (15.5°C) and 70°F (21.1°C). All cultivars stored at 70°F (21.1°C) produced an increase in plant number over the 60°F (15.5°C) storage.

INTRODUCTION

Importance of the Study

Sweet potato breeding for varietal improvement is considered by many researchers to be one of the principal means of maintaining the viability of the sweet potato industry in the United States of America and elsewhere in the world. Pope (89) in 1970 stated that "since the first sweet potato breeding program was initiated over 30 years ago by Dr. Julian Miller at Louisiana State University, more than 40 new cultivars have been developed in the United States with 'Centennial' the most widely grown". He further stated "that improvements that have resulted from the breeding program include higher yields, more attractive skin colors, higher carotene and ascorbic acid contents, and resistance to some insects and diseases".

The continued success of the sweet potato breeding program, as with all human endeavors, has its limits and if further successes are to be attained, an understanding of the genetic characters, mode of transmission, heritability and germplasm material are of paramount importance. As Hernandez (36) stated, "we must continually examine and re-examine our methods in order to efficiently utilize and maximize our efficiency in our plant improvement program".

Data on heritabilities are among the helpful guides to be used in redesigning for efficiency in breeding and selection strategies. Also data on correlation coefficients between characters are important and can be used effectively in applying selection pressure.

Statement of the Problem

Presently, the sweet potato breeding program in the United States, and particularly at Louisiana State University, basically involves the selection of genotypes with as many superior characters as possible to be entered in a polycross mating system. The growing of true seeds obtained from the polycross nurseries and subsequent selection pressure on these seedlings mandates a system of screening and prudent selection. Spectacular progress has been achieved for the last three-and-a-half decades with this system of breeding as used at Louisiana State University (37). However, it has been observed that improvement in yield may reach a plateau pointing to a limited potential for developing newer genotypes with higher yields unless changes are made in the breeding procedure taking into consideration the performance of progenies of the high yielding parents in polycross nurseries and in controlled crosses. Also to be considered may be the possibility of improving characters related to yield such as shorter vine internodes, vigor plant production and others to produce better genetically balanced and efficient cultivars.

Storage ability of fleshy roots and plant production are two characters that have been treated in many cases as minor breeding objectives; however, more emphasis is needed since a variety is not acceptable unless it stores well and sprouts sufficiently for propagation and increase.

With the present trend for energy conservation, it may be worthwhile to determine if some genotypes could be developed that will incur lower weight losses in storage not only under conventional storage temperatures of 60°F (15.5°C) but also under higher temperatures of 70-75°F (21.1-23.9°C) requiring less energy to maintain than the 60°F (15.5°C) storage rooms in tropical climate.

Several studies on the genetics and inheritance of various sweet potato characters have already been undertaken involving the use of controlled biparental crosses which is the classical system of studying genetic characters of most crops. Data from studies with controlled biparental crosses are useful as guides for selecting breeding parents for entry in a polycross nursery system. Because of the of the large amount of self and cross-incompatibilities that exist in the sweet potato, studies using polycross mating are more convenient, simpler and more practical.

Objectives of the Study

The present study was conducted using selected breeding parents in a polycross nursery to obtain progenies from maternal parents to determine the heritabilities of yield, storage ability and plant production and to determine the association between these characters and between each of them with several other genetic characters. The objectives of this study were more specifically as follows:

1. to compare the frequency distribution, means, and variances of the polycross progenies for several quantitative characters:
2. to determine the genetic variance and heritability of each selected character;
3. to determine phenotypic correlations between characters;
4. to study the differences in yield, dry matter content, and baking quality of fleshy roots among advanced seedlings;
5. to study storage ability and plant production of cultivars under two temperature regimes: 60°F (15.5°C), and 70-75°F (21.1-23.9°C).

LITERATURE REVIEW

Techniques Used for Sweet Potato Improvement

The sweet potato, being of tropical origin, rarely bloomed in the Continental United States before Miller (80, 81) in 1937 reported on techniques to induce the sweet potato to bloom. Until then, attempts to improve varieties of sweet potatoes in the United States had been by the selection of new types that occasionally appear as mutations (79). The frequency of mutations in the sweet potato, though considered higher compared to other crop species, was observed by Miller (79) and others (37, 41) to be low with one visible mutation in every 1,000 plants. Also, it was observed that, in most cases, these mutations were retrogressive, therefore, the plant breeder had to work with a very large number of plants before a chance desirable mutation occurred (35). However, contribution by this method to improve sweet potatoes should not be overlooked since some outstanding mutants have been named and released such as Unit I Porto Rico and others listed by Edmond (22). Presently, this method has a reduced role and is used only as a complement to hybridization which is the principal tool for producing plant variation and new recombinations with good horticultural characters (37).

Hybridization of sweet potatoes in the United States was made possible with the development of techniques used to induce flowering and seed set under greenhouse conditions (80) and later by using selected parents that flowered and set seed under field conditions (81).

At Louisiana State University, the sweet potato breeding program uses a polycross master nursery system having ad hoc nurseries. Controlled hybridization was used to study certain genetic characters (36). The polycross nurseries include: 1) a master nursery with 50 to 60 highly selected parents for most of the horticultural characters; 2) a soil rot nursery with 10 to 15 selected parents all having high levels of resistance to soil rot and other diseases and most of them having good major horticultural characters; 3) a root-knot nursery; and 4) and insect and industrial nursery (36). These nurseries produce 60,000 to 100,000 true seeds each year. A number of genotypes with superior characters have been obtained from this breeding program some of which are presently being entered in the regional trials of the National Sweet Potato Collaborators Group (36).

In 1965, Jones (48) proposed a breeding procedure for the sweet potato. The procedure basically involves selecting 4 to 20 plants, intermating them, and bulking the seeds in every generation for four generations without selection to establish a randomly interbreeding base population. Thereafter, part of the seeds (about 500 seeds) may be used to maintain the base population in the original manner and the rest of the seeds may be used to form as many sub-populations as possible or desired and altering each sub-population through selection towards planned breeding goals. The advantages of such a breeding procedure, Jones (48) averred, include: 1) it would utilize both intra- and inter-chromosomal recombinations; 2) allow expressions of new epistatic effects in each generation; 3) circumvent unintentional attempts to fix and transmit epistatic effects; 4) provide an orderly improvement in parental types each year; 5) entail no handcrossing; and, 6) require no detailed records. Its disadvantage, Jones (48) stated, is the time required to establish a randomly interbreeding population. At the time that Jones proposed this breeding procedure, not enough was known of the appropriate manner and intensity of selection for maximum genetic advancement, and the techniques of introducing new variability, i.e. disease resistance, without having to start an entire new population (48).

It should become clear, however, on reading the ensuing series of published articles that the breeding procedure Jones proposed in 1965 was actually a written articulation of what he considered then as the theoretical basis of the breeding program that he had just started. It should, also, be apparent that his breeding program was designed not only to produce genotypes for possible release as outstanding varieties but was set up primarily to generate data for use in testing, forming and verifying quantitative genetic concepts as specifically applied to the hexaploid sweet potato. Therefore, he had to use as starting parents, a broad enough sample of sweet potato genotypes to satisfy the assumption of an unbiased sample of all sweet potatoes, in order that results could be interpreted more broadly (48) which is problematical.

Genetics of Some Characters in Sweet Potato

In common with other crop plants, the sweet potato possesses both qualitative and quantitative characters (22). Qualitative characters are easily distinguishable from each other, are distinct and when arranged in an array, are discontinuous; whereas, quantitative characters are indistinct and continuous and when arranged in an array, grade into each other gradually with no clear-cut boundary separating different classes (1, 22). Most sweet potato breeders may already have some generalized ideas as to which sweet potato characters are qualitatively and which are quantitatively inherited but the mode of inheritance has been studied only to a limited degree. Jones (50) in his 1967 paper on the theoretical segregation ratios of qualitatively inherited characters for the hexaploid sweet potato stated "that qualitative genetic data for sweet potatoes are scarce, partially because it is a hexaploid with 90 chromosomes and partially because of the difficulties of selfing due to sterility, incompatibility and the failure of many types to bloom in temperate regions".

Of the few studies that have been undertaken, much useful information has been gathered that could aid in the development of improved breeding procedures. Poole (87) and others (22, 28, 50) reported that some sweet potato characters are qualitatively inherited. Qualitative characters controlled by one pair of genes according to Hammett and Edmond (22, 28) include: flower-forming being dominant over non-flower-forming; red stem dominant over green stem; and long internode dominant over short internode. They further reported that qualitative characters controlled by two pairs of genes include: fleshy root forming dominant over non-fleshy root forming; brown roots dominant over creamy white roots; smooth leaf margins dominant over slightly lobed leaf margins; and orange flesh dominant over creamy white flesh.

Jones (50) has raised some questions regarding the interpretation of the data of some of the previous studies primarily because of the complications posed by the hexaploid nature of sweet potato. He mentioned, as an illustration, the interpretation of Poole's (88) data which was interpreted to fit a diploid segregation ratio of 3:1. According to Jones (50), the actual ratio was 3.26:1 and using the theoretical segregation ratio for other types of inheritance, it was apparent that the observed segregation ratio fits equally well with other theoretical segregation ratios such as 2.69:1, 2.70:1, 2.79:1, 2.98:1, 3.01:1, 3.11:1 and 3.17:1.

In 1969 Jones, Steinbauer and Pope (57) stated that in the majority of sweet potatoes chromosome pairing occurs in a regular bivalent manner during meiosis and that qualitative genetic studies indicate that many character segregations can be explained on the basis of multiple factor disomic models--thus quantitative genetic theories, although formulated for use with diploids, may be applicable to the hexaploid sweet potato.

Hernandez (36) and others (51, 22) stated that the mode of inheritance for the quantitative characters in the sweet potato, as with all crop plants, is complex; these characters are usually controlled by a large number of genes and some of these genes may exist on the same chromosomes. Some of the sweet potato characters that have been shown to be quantitatively inherited by Hernandez et al. (44), Hammett (28), Constantin (12) and others (22, 46) include: root skin and flesh color, dry matter content, culinary qualities, resistance to Fusarium wilt, yield, root shape, cortex thickness and resistance to other diseases. Of these characters, Hammett (28) working with very small populations, reported that low yield appeared partially dominant over high yield; low carotene content partially dominant over high carotene content; and poor flavor partially dominant over good flavor. Those characters lacking in dominance which appear to be controlled by genes with additive effects include: root shape, dry matter content, and moistness of baked roots (28).

Hammett (28) also noted that some of the quantitative characters studied--whether exhibiting partial dominance, i.e. cortex thickness and carotene content or lacking in dominance, i.e. dry matter content and moistness of baked roots--segregated transgressively. Transgressive inheritance for some characters have a great practical significance (22) because they show that individuals may be discovered which have a higher degree of superiority than the original parent, and a higher degree of inferiority than the original inferior parent. Thus, Edmond (22) stated, "by using both superior individuals as parents in breeding programs and by discarding the inferior individuals, the gradual upgrading of important quantitative characters can take place".

In at least one character, i.e. skin color, Hammett (28) observed that in all progenies among the 21 parental combinations, the female parent appeared to have exerted greater influence than did the male parent apparently indicating that maternal effect or extrachromosomal inheritance may also occur in sweet potato but proof is not sufficient.

In 1963, Hernandez (46) found that white was partially dominant over light orange flesh color. This result was confirmed later by Constantin (12) who further reported that whenever two parents having roots of white flesh color were crossed, 100% of the seedlings in the progeny had white flesh.

In reviewing previous studies, Hernandez (36) stated that skin color of fleshy roots is quantitatively inherited, being controlled by several genes. He based this statement from the following data: crosses between copper colored parents gave approximately 44% of the seedlings with copper skin color and 21% were purple; in crosses between parents with rose and purple skin color, 85.7% of the seedlings had purple skin and 9.5% were rose; in a cross of cream X purple root skin parents, 40.6% of the seedlings were purple, 21% rose, 21.9% copper and 15.6% tan; in some crosses of copper X copper and copper X rose skin colored parents, approximately 50% of the progenies were copper skinned seedlings.

Hernandez (36) further noted that, of the several genes controlling skin color, a basic gene D for color is apparently present, R is a red or copper producing gene, and P a purple producing gene.

Other sweet potato characters shown to be quantitatively inherited include: resistance to banded cucumber beetle, veining of fleshy roots, growth cracks on skin of fleshy roots and at least ten vine traits, i.e. vine diameter, vine length, leaf type, vine purpling, leaf vein purpling, leaf whorl purpling, and plant pubescence (56).

Heritabilities of Some Sweet Potato Characters

Falconer (23) stated that the heritability of a metric (or quantitative) character is one of its most important properties. The most important function of the heritability in the genetic study of metric characters, he continued, is its predictive role, expressing the reliability of the phenotypic value as a guide to the breeding value. The term heritability was first defined by Wright (109) and Knight (64) as "the portion of the observed variance for which heredity is responsible". Falconer (23), on the other hand, defines heritability as the ratio of additive genetic variance (V_A) to phenotypic variance (V_P).

Others (1, 4, 30, 76, 90) reported the practicability of using the two definitions as applied differently to different specific research situations. These latter researchers noted that the total genetic variance consists of additive genetic variance, dominance variance, epistatic variance and extra-chromosomal variance; and they realize that in many experiments, the additive genetic variance can not be computed separately from the other genetic components. They therefore prefer to categorize heritability into two forms: 1) narrow-sense heritability, and 2) broad-sense heritability. Narrow-sense heritability is the term they would use for the heritability as defined by Falconer (23) being the ratio of additive genetic variance and the total phenotypic variance and symbolize it with the squared small letter $\underline{h^2}$. Broad-sense heritability, on the other hand, is defined as the ratio of total genetic variance over the total phenotypic variance and symbolize it with the capital letter $\underline{H}$.

Several workers (4, 9, 23, 31) postulated that the particular component of genetic variance that can be estimated from the measured phenotypic values depend upon the degree of relationship of the individuals being measured. If the individuals were of the offspring and parent relationship, then the covariance between offspring and parent can be calculated. By theoretical considerations, it can be deduced (9, 23) that the covariance of offspring and parent is equal to one half the additive genetic variance, hence the heritability that can be estimated from this type of relationship satisfies the definition of narrow-sense heritability. On the other hand, if the relationship of the individuals were of full-sibs, then the covariance of full-sibs can be calculated and since by theoretical considerations, the covariance of full-sibs can be deduced to be equal to one-half the additive genetic variance plus one-fourth the dominance variance, then the heritability that could be estimated from a study involving full-sibs would be closer to the type of heritability referred to above as broad-sense heritability--the experimenter being unable to estimate separately the additive genetic component.

The role of heritability estimates was pictured by Dudley and Moll (20) as being of value in all three stages of any plant breeding program: in the assembly or creation of a pool of variable germplasm; in the selection of superior individuals from the pool; and in the utilization of the selected individuals to create a superior variety. Dudley and Moll (20) also stated that the estimation of additive and non-additive genetic variance requires the use of appropriate mating and environmental designs. Cockerham (9) defines mating design as the system of mating used to develop progenies. A number of mating designs have been in use to determine additive genetic variances and heritability which include:

the diallel cross, Comstock and Robinson's (11) designs I, II and III, and the partial diallel which are two factor designs; and the triallel and quadriallel which are three and four-factor designs respectively (9). A set of half-sib families or polycross progenies would constitute a one-factor design (9, 20). In choosing a mating design, the simplest design which will provide the required information is preferred. A one-factor design is sufficient to detect presence of genetic variability, but for separation of additive and dominance variance, a two-factor design is necessary and for estimation of epistatic variance, a more complex design or combination of designs is required (20).

In 1977, Jones (53) stated that the concept of heritability and other quantitative genetic principles as they apply to the sweet potato have been investigated during the past decade in considerable detail. He further stated, "that genetic information about many traits of direct economic importance remain to be investigated". Heritability estimates for some characters in the sweet potato have been reported by Hernandez (36), Thibodeaux (99), and other workers (10, 28 51, 53, 56, 57).

In 1963, Jones (48) set up a randomly intermating population comprising of sweet potato plants of as diverse origin as available and considered an unbiased sample of all sweet potatoes.

Quantitative genetic studies were done on ten root traits (57) and on ten vine traits (51) using the fourth generation of this interbreeding population. It was found that heritability estimates for root and vine traits varied from location to location and from year to year. For root weight, heritability estimates varied from 21% to 60% with 21% as the heritability value for all locations and years; for number of edible roots, heritability estimates ranged from 0% to 55% with 32% as the heritability value for all locations and years; for flesh color, heritability ranged from 59% to 74% with a heritability value of 66% for all locations and years; while heritability for skin color ranged from 49% to 90% with a value of 81% for all locations and years.

Jones (51) stated that vine traits, in general, had a larger proportion of the phenotypic variance accounted for by the genetic variance than for root traits. Consequently, heritability estimates for the vine traits were very high. Heritability estimates for vine diameter ranged from 70% to 111% with a value of 111% for all locations and years; heritability estimates for vine length ranged from 29% to 76% with a value of 60% for all locations and years; for internode length, heritability ranged from 41% to 62% with a value of 61% for all locations and years; for leaf shape, heritability ranged from 48% to 66% with a value of 59% for all locations and years; while for leaf whorl purpling, heritability ranged from 67% to 84% with a value of 74% for all locations and years (57).

Using a population with a genetic background slightly different from those they used in their 1969 studies, Jones (53) in 1977 reported heritability estimates for root weight, flesh color and cortex thickness of 25%, 53% and 25% respectively. He stated that although these heritability estimates were lower than those previously estimated (53), these estimates were within the range of estimation for the separate environments.

Heritability estimates can vary from location to location, year to year, and more importantly, from population to population, and the results of Jones (53) indicate this. Several workers (31, 92, 57) stated that heritability estimates for any particular trait of a crop plant, strictly speaking, applies only to a particular population under study..

Yield as a Major Breeding Objective

Hernandez (36) stated that in a period of 40 years of sweet potato breeding at LSU, yield increases are possible; 'Centennial', released in 1960, produced an average yield increase over 'Porto Rico' of 2.5 tons/acre (6.2 tons/hectare) and a recent seedling, 'LO-323' produced comparable yield increases over 'Centennial'.

Attempts to better understand the range and limits of sweet potato yielding potential have been made and possible approaches suggested and/or attempted all aimed at attaining further yield advances beyond what have been previously or presently achieved. Hernandez (36) stated that there are complex environmental-hereditary interactions in sweet potato breeding that have to be considered when applying selection pressure for yield. Scientists (51, 61, 59) found very high variability of the same cultivars from location to location and year to year. Haynes (33) stated that it is well known that single plants of sweet potatoes show wide differences in yield within a few feet in a row. Boudreaux and Jones (5) found a coefficient of variation ranging from 5% to 50% in replicated yield experiments of sweet potatoes. Wilson (108) tried to look at yield from the approach of inter- and intra-varietal variation in sweet potatoes by examining the morphological, anatomical and biochemical aspects of the process of tuberization and by trying to determine the physiological implications of these considerations.

Other approaches to the problem of yield differences have been employed by other workers. Kim (62) tried to look at the development of storage roots of the sweet potato. He observed that the growth of the tops of the plant was similar to the growth of the storage roots up to nine weeks from transplanting but thereafter, the growth of the storage roots exceeded the growth of the tops. He further observed that the increase in fleshy root dry weight occurred concurrently with a decrease of top dry weight. Varietal differences in yield was approached by Hahn (26) through an analysis of the differences in the contribution by the root and shoot processes. They reported that differences in photosynthetic ability among cultivars may account for some of the differences in yield. They further stated that the ability of the roots to accumulate the translocated photosynthates (the roots acting as a sink and the top acting as a source) can partly explain the varietal differences in yield.

Yield shall continue to be a major breeding objective and no cultivar would probably be released as a variety unless it has higher yield than the prevailing varieties. The only exception would be a variety with other characters as disease or insect resistance (37).

Resistance to Losses During Storage

Only a small portion of the sweet potato crop produced in the United States is used for processing. Sweet potatoes for canning or other uses are processed shortly after harvest (37) therefore presenting no storage problem. Sweet potatoes sold on the fresh market must be stored after curing and this storage period may last for several months. Curing the freshly harvested sweet potato roots at 85°F (29°C) and relative humidity of 85% for seven to ten days followed by storage temperature of 60°F (15.5°C) and a relative humidity of 85% has been found under various experimental and commercial conditions by various workers (18, 65, 66, 67, 68, 69, 70, 78, 98) to be effective in reducing losses during storage for most sweet potato cultivars.

Varietal differences in the ability of sweet potato fleshy roots to resist losses in storage have been observed by various investigators (65, 70). A number of varietal traits have been shown to account for the varietal differences in storage ability. Kushman and Pope as cited by Dempsey, Kushman and Love (18) reported that sweet potato cultivars that incur high losses in storage either have high respiration rate, high moisture losses, high intercellular space at harvest and/or show volume changes conducive to development of pithiness.

Plant Production by Fleshy Roots

In the United States as well as the rest of the sub-tropical and temperate areas of the world, propagation of sweet potatoes must at least initially involve the production of plant slips from fleshy roots stored from the previous years harvest (71). A cultivar therefore must possess an optimal ability to produce a fairly large number of plants or slips per fleshy root in order for it to be commercially acceptable (71). Previous studies show that depending on the number of pullings from the seeded fleshy roots, it takes 6 to 10 bushels of seed potatoes to plant an acre of sweet potatoes (71) which is a costly part of production.

Varietal differences in the ability to produce plants have been reported (3, 7, 29, 40, 83, 86). Among the established sweet potato varieties, 'Porto Rico' has been shown to be a very high plant producer; 'Centennial' is moderate and 'Julian' and some of the relatively newly released varieties are not as good plant producers (71). Recently, a technique to partly improve the plant producing ability of the poor or moderate varieties has been suggested (19, 29). This involves the pre-sprouting of the seed roots by transferring these from the 60°F (15.5°C) storage rooms to 85°F (29.4°C) with a high relative humidity for four to six weeks allowing them to produce sprouts about 2 inches in length before bedding (71).

In evaluating the effects of some factors on plant production, Hammett (29) stated that preheating increased sprout earliness regardless of cultivar, seedpiece size, or method of harvest and that seedpiece size affected both number and size of transplants. He further stated that when sprouts were cut, first harvest was later when compared to pulled but subsequent harvests were earlier and total plant production was greater regardless of cultivar, preheating treatment or seedpiece size.

MATERIALS AND METHODS

This research consists of two studies: 1) genetic study of sweet potato cultivars under a polycross system of mating; and 2) a comparison of characters of sweet potato advanced cultivars developed from the polycross breeding system.

Study 1. Genetic Study of Sweet Potato Cultivars Under Polycross System of Breeding

In Table 1 is shown a list of the parents entered in the Master Polycross Nursery at LSU for polycross seed production. The major horticultural traits of each parent are also shown. 'LO-323' was the maternal parent for the 1978 test and 'Centennial', 'LO-323', 'L9-163', 'L4-312' and 'L8-343' in 1979. Centennial has several desirable horticultural traits and is presently the major sweet potato variety in Louisiana. 'LO-323' is an advanced cultivar that has consistently shown very high yield potential (2, 36, 47, 101). 'L9-163' was another cultivar which has disease resistance and good horticultural characters, produces a large number of fleshy roots per hill and the vines branch freely and have short internodes but did not give yields as high as 'LO-323'. 'L4-312' was an advanced cultivar with many similar traits as 'L9-163' produced moderate yields but with fleshy roots that have extensive skin and cortical growth cracks. 'L8-343' was a parent kept in the germplasm nursery because

Table 1. Major horticultural characters of the maternal parents sampled from the Master Polycross Nursery.

Characters	Centennial	L0-323	L9-163	L4-312	L8-343
Photoperiod	M	M	M	L	L
Flower production	good	fair	fair	very good	good
Seed set	good	fair	fair	very good	good
Plant vigor	good	very good	fair	fair	fair
Maturity	M-E	E	L	M	M
Root yield	H	H	M	M	L
Skin color	Cu	Lt. Cu	Cu	Cu	R
Flesh color	7	6	7	5	7
Quality	8	5	5	6	6
Dry matter	7	4	6	5	4
Soil rot	S	S	R-I	R	R
Root knot	S	I	S-I	s	I
Internal cork	I	R	R	R	I
Stem rot	I	R	I	I	I

Photoperiod: L = long (15 hrs+); M = moderate (13-15 hrs); S = short (12 hrs); Maturity: E = early (100-120 days); M = moderate (120-140 days); L - late (140 days+); Yield: L = low; M = moderate; H = high; Skin color: Cu = copper; R = rose; P = purple; Flesh color: 0 = white; 1-4 = low carotene; 5-6 = moderate or acceptable; 7-10 = very good; Dry matter: 1-4 = low (18-22%); 5-6 = moderate (23-26%; 7-10 = high (27%); Diseases: S = susceptible; I = intermediate resistance; R = resistance. Quality: 1-10 with 10 representing highest expression of quality.

of its disease and nematode resistance but it produces low yields of fleshy roots with low dry matter content.

True seeds collected from the Master Polycross Nursery were treated for 20 minutes in concentrated sulfuric acid (H_2SO_4) and then washed with tap water, dried at the Department of Horticulture, LSU, Baton Rouge. They were then collected in small bags and sent to the Sweet Potato Research Center, Chase, Louisiana for planting in a seedbed in the greenhouse. When the seedlings had formed small sized roots, they were pulled and whenever possible, 250 seedlings were randomly selected from each maternal parent, brought to LSU and rated for root skin and flesh color.

Fleshy roots were then removed and vines were cut leaving about 20 to 30 centimeters of the basal portion of the vine for use in planting at the Hill Farm, LSU on May 21, 1978 and on May 17, 1979. The field was fertilized at recommended rates of 30.7 kg N, 56.1 kg P_2O_5 and 30.7 kg K_2O per hectare, rotavated and ridges formed. The plants were placed about 2½ inches (5 centimeters) deep at a planting distance of 2 feet (61 centimeters) between hills and 4 feet (1.22 meters) between rows. This simulates the first vegetative propagation practiced at LSU in handling the 60,000 to 100,000 true seeds produced in the polycross breeding system each year. The major difference for this test compared with the normal

Table 2. Method, time and unit of measurement for the characters in the 1979 polycross progeny test.

Character	Unit of measurement	When and how measured
Root characters:		
Skin color	Rating 1-5	7 months after sowing true seeds in greenhouse, 1 = white, 5 = purple
Flesh color	Rating 1-5	7 months after sowing true seeds in greenhouse, 1 = white, 5 = deep orange
Root weight	Pounds	141 days from planting
Weight loss	% of weight at harvest	5 months after storage at 60°F
Sprouting in field bed	No. sprouts/root	52 days and 82 days from bedding
Vine characters:		
Vine length	Centimeter	41 days after planting from tip to base
Vine diameter	Millimeter	41 days from planting at 6th internode from the first fully opened leaf counting towards the base
Vine color	Rating 1-5	40 days after planting 1 = green, 5 = purple
Internode length	Centimeter	41 days after planting at 6th internode from node of first fully opened leaf counting towards the base
Number of branches	Number	40 days from planting
Young foliage color	Rating 1-5	40 days from planting, 1 = green, 5 = deep purple

Table 2. Method, time and unit of measurement for the characters in the 1979 polycross progeny test. (continued)

Characters	Unit of measurement	When and how measured
Leaf shape	Rating 1-7	40 days from planting, 1 = deeply lobed, 7 = perfectly heartshaped
Leaf vein	Rating 1-5	40 days from planting at the bottom surface of the 6th leaf from the first fully opened leaf counting towards the base, 1 = green, 5 = purple
Petiole length	Centimeter	41 days from planting at 6th petiole from petiole with first fully opened leaf counting towards the base

handling of polycross seedlings was that no selection pressure was practiced.

The field was kept weed-free both by mechanical and hand cultivation.

Data on root and vine characters were measured as shown in Table 2. Frequency distributions, progeny means, and coefficients of variation were determined for root skin and flesh color, yield of different grades of fleshy roots and total fleshy roots for all the five parental families. Genetic variance, heritability and expected gain from selection were estimated as described below.

Estimating Genetic Variance and Heritability

The reference population in this test is the population of sweet potatoes in the Master Polycross Nursery. The test was carried out taking into consideration the following assumptions which Cockerham (9), Becker (4), and Dudley and Moll (20) stated should be considered in estimating genetic variances: 1) population in random mating; 2) population not inbred, F = 0; 3) population in normal diploid inheritance; 4) progenies not inbred and can be considered random members of non-inbred population; and 5) population in linkage equilibrium.

The mating design was a polycross also referred to by Cockerham (9) as a one-factor mating design. The data was analyzed following the method of Becker (4). Essentially, the procedure involved: 1) the partitioning of the total phenotypic variance into their components by conventional Analysis of Variance (ANOV) procedure; and 2) interpreting genetically the components of variance of the ANOV by translating them into covariances of relatives.

The statistical model for the ANOV was:

$$Y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$$

where Y_{ij} = $j^{\underline{th}}$ observation within $i^{\underline{th}}$ group; μ = overall mean; α_i = effect of $i^{\underline{th}}$ group; and ε_{ij} = residual or error.

Table 3 shows the degrees of freedom and expectation mean squares for the ANOV.

The component of variance due to differences between parental group, σg^2 was then estimated:

$$\sigma g^2 = \frac{MSg - MSw}{k}$$

Since the relationship between progenies within parent group was half-sibs, then:

$$\sigma g^2 = cov_{hs}$$

where cov_{hs} is the covariance of half-sibs.

The genetic interpretation for the variance component:

$$\sigma g^2 = cov_{hs} = \tfrac{1}{4} V_A$$

where V_A is the additive genetic variance.

Table 3. Analysis of variance with expected mean squares.

Source of variance	Degrees of freedom	Mean square	Expectation mean square
Total	$\Sigma n_i - 1$		
Between parental group	$q - 1$	MSg	$\sigma_\varepsilon^2 + k\sigma g^2$
Within group	$\Sigma n_i - q$	MSw	σ_ε^2

Note: Σn_i = number of all i; 1 = number of parent groups; σg^2 = component of variance due to within groups or error; σ_ε^2 = component of variance due to differences among parent groups; and k = coefficient, approximately the average number of progeny per parent group.

Heritability in the narrow sense, h^2 was estimated as follows:

$$h^2 = \frac{4\ V_A}{\sigma_W^2 + \sigma_g^2}$$

Expected gain or response, R from selections as percent of the mean was estimated from the formula of Falconer (23):

$$R = \frac{i\ V_A\ h^2}{\overline{Y}} \times 100$$

where i is intensity of selection and assuming a selection of the top 5% of the population, i = 2.06; and $\overline{Y}$ is the observed mean; V_A and h^2 are as defined above.

Study 2. <u>Comparison of Sweet Potato Cultivars</u>

Some of the horticultural characters evaluated include: yield, dry matter content, weight loss in storage at two temperature regimes, and plant production of roots previously stored at two temperature regimes.

<u>Yield Test (1978)</u>

The test was conducted in two locations on the Hill Farm at LSU with the same procedure for both locations. Sprouts (plant slips) from bedded fleshy roots in each of 20 cultivars were pulled and planted in the field on June 12, 1978. The field was fertilized at recommended rates of 30.7 kg N, 56.1 kg P_2O_5 and 30.7 kg K_2O per hectare, rotavated and ridges formed. The planting plan was a randomized complete block design (RCB) with four replications. Each replication consisted of 20 plants per plot measuring 20 feet (6.1 meters) long X 4 feet (1.22 meters) wide. Plants were placed approximately 2½ inches (6.3 centimeters) deep on top of the ridge and spaced one foot (30.5 centimeters) apart. The field was kept weed-free and cultivated according to recommended practices. Sweet potato roots were harvested on October 23, 1978 and graded into US #1, US #2 and Jumbo sizes, and then weighed.

Yield Test (1979)

The same land preparation, planting design, plot size, fertilization rate and distance of planting was followed in 1979 as in 1978. The only differences were that instead of 20 cultivars, only 11 cultivars were selected from those tested in 1978. One irrigation was applied at one stage of growth in 1979. This test was planted on June 7 and harvested on October 10, 1979.

Dry Matter Content Determination

Percent dry matter content of fleshy roots were determined gravimetrically at harvest and at the end of the 5 months of storage at two temperature regimes using the same procedure for 1978 and 1979. Three US #1 roots were randomly selected from each cultivar in each replicate. The roots were washed and allowed to dry. Samples were taken using a cork borer making two to three bores per root to make about 12 to 16 grams of fresh root samples in a pan.

Two pan plus samples were prepared for each replicate in each cultivar. All samples were placed in an oven previously heated to a temperature of 70°C and held there for 24 hours. At the end of the drying period, the pan plus samples were placed in a dessicator, allowed to cool for 10 to 15 minutes and then weighed. During the first test, each weighed pan plus sample was returned to the desiccator and after 2 to 3 days was weighed again to see if changes in weight could be observed--no change was seen. The dry matter content (%) was computed from the following formula:

$$\%\ \text{Dry matter} = \frac{(\text{Pan plus sample dry weight}) - (\text{Pan weight})}{(\text{Pan plus sample fresh weight}) - (\text{Pan weight})}$$

Storage Ability Test (1978)

Storage losses from fleshy roots of each of 20 cultivars stored at two temperature regimes were studied. There were 25 US #1 roots in each of 8 replications used in the storage test. Four replications were placed after curing in a storage room where the temperature was maintained at 60°F (15.5°C) and a second treatment of four replications was placed in another storage room where temperature was maintained at 70°F (21.1°C) with both storage rooms being maintained at approximately 85% relative humidity. Weighings of the roots were done before curing, at the end of curing, and every four weeks during storage. After 20 weeks in storage for both storage rooms, the roots of each cultivar were divided into samples for dry matter determination, organoleptic rating and sprouting ability tests.

Storage Ability Test (1979)

The root sampling, number of roots per replication and per cultivar, curing and storage conditions and experimental design were the same as in 1979. Only 11 cultivars were used with two replications per storage treatment. Instead of using cloth bags as containers for the sweet potatoes as used in 1978, perforated card-board boxes were selected to minimize bruising. As with 1978, at the end of the storage period, roots of each cultivar were divided into samples for dry matter determinations, organoleptic rating and sprouting ability tests.

Organoleptic Quality Test (1978 and 1979)

Organoleptic quality tests for both 1978 and 1979 consisted of two replications of each cultivar per storage temperature regime$. One root per replication for each cultivar was baked in an oven previously heated to 400°C and then maintained at 375°C for one hour and 10 to 20 minutes. Baked roots were then removed from the oven, cut in half by a knife and allowed to cool for ten minutes. A tasting panel rated each cultivar on the quality factors of color, flavor, texture and fiber content using a rating scale of 0-10 with 10 representing the maximum favorable expression of the factor. The ratings on these four factors were added and divided by four to give the baking index for each cultivar. In 1978, there were a total of eight members of a panel of tasters using two replications and in 1979 there were nine members.

Sprouting Ability Test (1978)

Fleshy roots from the storage test at two temperature regimes were bedded following a randomized complete block design with four replications arranged in a split plot using storage temperature as the main plot and cultivars as the sub-plots. Each replication consisted of an area 4 feet (1.22 meters) X 4 feet (1.22 meters). Ten roots per replication of each cultivar were bedded in a furrow made on top of a ridge and covered with 2 inches (5 centimeters) of soil on April 10, 1978. The field was kept weed-free both by mechanical and hand cultivation. When moisture was observed to be inadequate, irrigation was applied. The first harvest of plants was made on May 21, 1979 when the early sprouts were about 20 centimeters in length. Weekly cuttings were made thereafter for a total of seven cuttings. The first three cuttings were totaled to represent early sprouts and the last four cuttings were totaled to represent the late harvest. The total early and late sprouts for each cultivar gave the total sprouting ability.

Sprouting Ability Test (1979)

A similar procedure and statistical design was followed as in 1978 except that only 11 cultivars were used in the 1979 test. Twenty roots of each cultivar in each replication were used. Also, only two replications were employed and a total of three cuttings were made; the first cutting representing the early harvest and the last two cuttings were totaled to give the late harvest.

INTERPRETATION OF RESULTS

Study 1. Polycross Progeny Tests

Polycross Progeny Test in 1978

The frequency distribution, progeny means and coefficient of variation for skin and flesh colors of the fleshy roots of the 'LO-323' polycross seedling progeny are presented in Table 4. All of the hills of 'LO-323' were rated 3 or copper in skin color and all were rated 4 or deep orange root flesh color. Data in Table 4 show that the 202 seedling progeny of 'LO-323' was distributed into each of the five skin color classes as follows: 19.3% in class 1 (white to cream skin); 16.8% in class 2 (tan skin); 26.2% in class 3 (copper skin); 15.6% in class 4 (rose or pink skin) and 21.8% in class 5 (purple skin). These results are interesting since the desirable root skin colors are classes 3 (copper skin) and 4 (rose skin). Seedlings in class 2 (tan skin) would be, in some instances acceptable, so that if selection for skin color as conventionally practiced at LSU were to be practiced in this 'LO-323' polycross progeny, a relatively high percentage of the 202 progeny (36.3%) would have a chance of being selected for further testing if based on the character alone. The 'LO-323' polycross progeny mean for root skin color was 3.03 which was very close to the rating of the parent plants; the coefficient of variation was 104.2 showing the high variability in the polycross progeny. This kind of variation allows the breeder to exercise some selection pressure for seedling skin color. Seedlings of the 'LO-323' polycross progeny segregated for flesh color as shown in Table 4. A relatively high percentage of the polycross seedlings (24.6%) were in class 1 (white to cream skin) which is not a desirable flesh color in the present breeding program in the United States. However, the white flesh color in a new cultivar could be desirable in some areas of the world. The most desirable flesh color of seedlings belong to classes 4 (orange) and 5 (deep orange). The 'LO-323' polycross progeny had 20.1% and 19.6% of the segregating seedlings in classes 4 and 5, respectively for a total of 40% that qualified for further testing if selection were based only on this character.

Data in Table 5 show the frequency distribution, progeny mean, and coefficient of variation for total root yield of a polycross seedling progeny of 'LO-323' together with hills of cultivars of 'Centennial', 'Jasper', and 'LO-323'. Yields of 'Centennial', 'Jasper' and 'LO-323' hills fell on or above the median class yield (2.1-4.0). Forty percent of the 'Centennial' plants were in the median class yield and 60% were in the next higher class; for 'Jasper', 20% were in the median class and 80% fell in the next higher class; and for 'LO-323', 40% were on the median class, 40% in the next higher class, and 20% were in the highest class. The mean yield of 'LO-323' hills was higher than the means of 'Centennial' and 'Jasper'.

Of the 202 'LO-323' polycross progeny seedlings that were initially planted, 37 died. Of the 165 that reached maturity, 12.7% did not produce any fleshy roots, 46.1% had very small roots (low yield), 29.7% belong to the median class, 9.1% fell in the next higher class, and 2.4% were in the highest class (Table 3). It appears that the majority of the 'LO-323' polycross segregating seedlings (58.8%) fell below the median class and are therefore low yielders; however, a few of the progenies (2.4%) had very high yield. The progeny mean is much lower than the mean of the 'LO-323' maternal plants and also lower than the mean of the 'Centennial' and 'Jasper' plants.

There was a very low coefficient of variation among 'Centennial', 'Jasper' or 'LO-323' plants compared to that of the polycross segregating seedlings. This is apparently because the cultivars were vegetatively propagated and the differences among plants within a cultivar are mostly due to environmental or chance causes while that of the 'LO-323' polycross progeny has a very high coeficient of variation indicating that each plant was genotypically different from each other. The variation among polycross seedlings is therefore a compounded effect of genotypic, environment, and genotype X environment interaction.

Table 4. Frequency and percentage[1] distribution, progeny means and coefficient of variation (CV) for skin and flesh color of fleshy roots in a polycross seedling progeny of LO-323.

Character	No. seedlings	Class[a] 1	2	3	4	5	Progeny mean	CV
Skin color	202	39 (19.3)	34 (16.8)	53 (26.2)	32 (15.8)	44 (21.8)	3.03	104.2
Flesh color	199	49 (24.6)	35 (17.6)	36 (18.1)	40 (20.1)	39 (19.6)	2.92	109.2

[a]Classes were based on visual ratings:

	Skin color	Flesh color
1	= white to cream	= white to cream
2	= tan or brown	= yellow
3	= copper or gold	= deep yellow
4	= rose or pink	= orange
5	= purple	= deep orange

[1]Values enclosed in parenthesis represents percentage distribution.

Table 5. Frequency and percentage[1] distribution, means and coefficient of variation (CV) in total root yield of cultivars and a polycross seedling progeny.

Cultivar/ progeny	No. of plants	Class (lb*/hill) 0	0.01-2.0	2.1-4.0	4.1-6.0	6.1-above	Mean	CV
Centennial	5	0	0	2 (40.0)	3 (60.0)	0	3.50	37.75
Jasper	5	0	0	1 (20.0)	4 (80.0)	0	3.67	31.46
LO-323	5	0	0	2 (40.0)	2 (40.0)	1 (20.0)	5.50	31.98
LO-323 progeny	165	21 (12.7)	76 (46.1)	49 (29.7)	15 (9.1)	4 (2.4)	2.59	104.1

[1]Percentage values are enclosed in parenthesis.

*1 lb = 453.7 grams

Polycross Progeny Test in 1979

Among the 53 cultivars that were entered in the LSU Master Polycross Nursery, five were selected for this test; namely, 'Centennial' ('L3-77'), 'L0-323', 'L9-163', 'L4-312' and 'L8-343'. Data on root skin and flesh color, fleshy root yield, vine characters, weight loss in storage, and sprouting ability were obtained and estimates of heritability and correlation among pairs of characters were computed. Results are presented and discussed in the sections that follow.

Root Flesh and Skin Color (1979)

As mentioned earlier the first selection pressure applied on the seedlings derived from true seeds of polycrossed sweet potato cultivars in the normal sweet potato breeding at LSU uses root flesh and skin color as major criteria with apparent dry matter content (by visual observation) and pest and disease damage as secondary criteria. Data in Tables 6 and 7 indicate what would have happened if the seedlings in this study were normally selected for flesh and skin color. Ratings of 4 and 5 (orange and deep orange, respectively) for flesh color would be desired and hence normally selected. Among the 122 polycross seedlings of 'Centennial' that produced fleshy roots, 27.9% and 14.7% belong to classes 4 and 5, respectively; of the 172 polycross seedlings of 'L0-323' that formed fleshy roots, 25.6% and 9.5% were rated 4 and 5, respectively; of the 129 polycross seedlings of 'L9-163', 31.8% and 8.5% were rated 4 and 5, respectively; of the 117 polycross seedlings of 'L4-312', 24.8% and 2.6% were rated 4 and 5, respectively; and, of the 24 polycross seedlings of 'L8-343' that formed fleshy roots, 41.7% and 12.5% were rated 4 and 5, respectively (Table 6). A higher percentage of the polycross seedlings of 'L8-343' followed by that of 'L9-163' would be selected on the basis of flesh color under normal selection procedures. This is also reflected in the progeny mean rating where the progeny mean of 'L8-343' is the highest followed by that of 'L9-163'.

The coefficients of variation were high for all of the five parental families which indicated a large amount of genetic variation existed among the seedlings.

Under conventional breeding procedure, seedlings selected on the basis of flesh color alone will not necessarily be advanced for the next planting and selection but will be concurrently screened on the basis of skin color with ratings of 3 and 4 (copper and rose colored, respectively) being desired. Data in Table 7 show that of the 122 polycross seedlings from the 'Centennial' parent that formed fleshy roots, 26.2% and 33.6% were rated 3 and 4, respectively being copper or rose skin color; of the 172 polycross seedlings of 'L0-323', 29.6%

Table 6. Frequency and percentage[1] distribution of polycross seedling progenies of sweet potato parents for flesh color.

Maternal parent	Total progeny	Class[a] 1	2	3	4	5	Progeny mean[b]	CV
Centennial	122	16 (13.1)	14 (11.5)	40 (32.8)	34 (27.9)	18 (14.7)	3.31	94.0
LO-323	172	14 (8.1)	22 (12.7)	76 (44.2)	44 (25.6)	16 (9.5)	3.49	85.5
L9-163	129	4 (3.1)	12 (9.3)	61 (47.3)	41 (31.8)	11 (8.5)	3.62	87.7
L4-312	117	10 (8.5)	26 (22.2)	49 (41.9)	29 (24.8)	3 (2.6)	3.22	83.2
L8-343	24	1 (4.2)	2 (8.3)	8 (33.3)	10 (41.7)	3 (12.5)	3.98	84.2

*CV = coefficient of variation.

[1]Percentage values are enclosed in parenthesis

[a]Classes were based on flesh color rating from 1 to 5, where:

1 = white to cream
2 = yellow
3 = deep yellow
4 = orange
5 = deep orange

[b]ANOV shows no significant differences between progeny means.

Table 7. Frequency and percentage[1] distribution of skin color for polycross seedling progenies of sweet potato maternal parents.

Maternal parent	Total progeny	Class[a] 1	2	3	4	5	Progeny mean	CV
Centennial	122	6 (4.9)	29 (23.8)	32 (26.2)	41 (33.6)	14 (11.5)	3.23	93.7
LO-323	172	6 (3.5)	25 (14.5)	51 (29.6)	65 (37.8)	25 (14.5)	3.45	89.6
L9-163	129	9 (7.0)	28 (21.7)	32 (24.8)	52 (40.3)	8 (6.2)	3.12	83.5
L4-312	117	1 (0.8)	32 (27.3)	21 (17.9)	52 (44.4)	11 (9.4)	3.34	90.2
L8-343	24	0	3 (12.5)	3 (12.5)	6 (25.0)	12 (50.0)	4.12	86.1

*CV = coefficient of variation.

[1]Percentage values are enclosed in parenthesis.

[a]Classes were based on skin color rating from 1 to 5, where:

1 = white to cream
2 = tan to brown
3 = copper or gold
4 = pink or rose
5 = purple

[b]ANOV shows no significant differences between progeny means.

and 37.8% were rated 3 and 4, respectively; of the 129 polycross seedlings of 'L9-163', 24.8% and 40.3% were rated 3 and 4, respectively; of the 117 polycross seedlings of 'L4-312', 17.9% and 44.4% were rated 3 and 4, respectively; and, of the 24 polycross seedlings of 'L8-343' that formed fleshy roots, 12.5% and 25.0% were rated 3 and 4, respectively. On the basis of skin color therefore, a small percentage of the 'L8-343' polycross seedlings would be selected under normal screening procedures.

It is important to note that there were no significant differences in the progeny means for the five parents. These five parents produced progenies that clustered around their respective means each having a low coefficient of variation. These data reflect the condition of the sweet potato germplasm at LSU indicating the advances that have been attained with respect to the selection of parents for root skin color.

The estimate of heritability for skin color was 0.131 and that of flesh color was 0.046 (Table 15). The low estimate of heritability for root flesh color may reflect the real heritability value for this character in the LSU sweet potato germplasm nursery since selection to attain high total carotenoids in this gene pool has continued for many years.

Data in Table 8 show that root skin color was positively correlated with the yield of US #1 roots and of total marketable roots but not correlated with number of US #1 roots nor with sprouting ability. Although the correlation coefficient between root skin color and root flesh color was not significant at the .05 level, the value is of a relatively high magnitude. Weight loss in storage of seedling progenies in general was not significantly negatively correlated with skin color although it was of some magnitude. The interesting observation is that a negative value is shown indicating that there is a possibility that root skin color could give a clue to weight loss in storage. The more darkly root skinned parents the greater the chances that less weight loss will occur when compared to lighter skinned parents.

Correlations between root skin color and each of several vine characters were also conducted as shown in Table 8. The importance of studying vine characters though they are of less direct economic importance was discussed by Jones (51). He stated that vine characters are easily studied and they can be very useful as monitors of population changes under various selection schemes. If correlations exist with root traits, vine traits could be included in selection indices for root traits. Moreover, young vines and leaves are important vegetables in Asian countries (102, 103, 104, 106). As shown in Table 8, root skin color was positively correlated with vine length, and vine diameter

Table 8. Correlations between root skin or flesh color and other root and vine characters in the 160 randomly selected segregating seedlings from five parents.

Characters	Skin color	Flesh color
Root characters:		
Total weight of roots	.205**	-.158*
Total number of roots	.132	-.124
Weight of US #1 roots	.166**	-.161*
Number of US #1 roots	.064	.043
Flesh color of roots	-.144	---
Weight loss in storage	-.142	.021
Sprouting in field bed	-.038	-.160*
Vine characters:		
Vine length	.246**	-.181
Vine diameter	.186*	-.287**
Vine color	-.157*	.045
Internode length	.009	.355**
Number of branches	.007	-.281**
Young foliage color	-.106	.117
Leaf shape	.105	.016
Leaf vein color	-.032	.145

*Denotes that the correlation coefficient is statistically significant at the .05 level.

**Denotes that the correlation coefficient is statistically significant at the .01 level.

with correlation coefficients of 0.246 and 0.186, respectively. A negative correlation of -0.157 was observed between root skin color and vine color. No correlation was observed between root skin color and internode length and number of branches.

Root characters negatively correlated with root flesh color include total weight and weight of US #1 roots and sprouting of roots in field beds with correlation coefficients of -0.158, -0.161 and -0.160, respectively. This is not a desirable association since the breeder wants to develop cultivars that should have high ratings for flesh color and at the same time have good yield (weight) and sprouting ability. Other root characters studied were not found to be significantly correlated with root flesh color (Table 8). For vine characters, root flesh color was positively correlated with internode length and negatively with vine diameter and number of branches with values of 0.355, -0.287 and -.0281, respectively (Table 8).

Yield (Weight) of US #1 and Total Roots (1979)

In Tables 9 and 10 shown the frequency distribution of the polycross progenies of the five parents in terms of their yield (weight) of US #1 and total fleshy roots, respectively. A large percentage of the progenies did not produce any US #1 roots at all: 34% for 'Centennial', 29.7% for 'L0-323', 52.8% for 'L9-163', 47.3% for 'L4-312' and 61.1% for 'L8-343'. In mean weight of US #1 roots in pounds, 'L0-323' progenies had the highest mean of 1.11 lb (0.51 kg) followed by the

'Centennial' progenies with 0.97 lb (0.44 kg) then by 'L4-312' with 0.63 lb (0.29 kg), 'L9-163' with 0.57 lb (0.26 kg) and 'L8-343' with 0.32 lb (0.15 kg).

The high percentage of progenies having no US #1 roots appears to be discouraging but in many cases these segregating seedlings have a large set of canners size roots or Jumbos. As shown in Table 9 only 4.7% of the 'Centennial' progeny seedlings produced US #1 fleshy roots and 'L0-323' had 8.2%; 'L9-163', 15.1%; 'L4-312', 16.3% and 'L8-34' had 19.4%. 'Centennial' progeny seedlings had the highest mean yield of total fleshy roots followed by that of 'L0-323', 'L9-163', 'L4-312' and 'L8-343'.

In both the yield of US #1 and total fleshy roots, most of the seedlings of the five parents generally had a skewed distribution to the lower yielding classes. The chances of selecting high yielding seedlings therefore are relatively low, hence the need to be cautious in selecting for yield if based on data from individual seedlings.

To aid the breeder in making appropriate decisions for the selection pressure to be exerted in certain populations, data on genetic variance and heritability were obtained as shown in Table 15. The weights of US #1 roots have a genetic

Table 9. Frequency and percentage[1] distribution of US #1 root yield (weight) of polycross seedling progenies of some sweet potato maternal parents.

Maternal parent	Total progeny	Class (weight in lb/hill)[b]					Progeny mean[a]	CV
		0	0.1-1.5	1.6-3.0	3.1-4.5	4.6-above		
Centennial	150	51 (34.0)	59 (39.3)	33 (22.0)	7 (4.7)	0	0.97	110.1
L0-323	182	54 (29.7)	72 (39.6)	45 (24.7)	7 (3.8)	4 (3.8)	1.11	105.6
L9-163	159	84 (52.8)	59 (37.1)	9 (5.7)	6 (3.8)	1 (0.6)	0.57	169.3
L4-132	129	61 (47.3)	48 (37.2)	18 (14.0)	2 (1.5)	0	0.63	129.4
L8-343	36	22 (61.1)	8 (22.2)	6 (16.7)	0	0	0.32	164.4

*CV = coefficient of variation.

[1]Percentage values are enclosed in parenthesis.

[a]$LSD_{.05}$ = 0.38; $LSD_{.01}$ = 0.49 for progeny means.

[b]1 lb = 453.7 gm.

Table 10. Frequency and percentage[1] distribution of total fleshy root weight of polycross seedling progenies of some sweet potato maternal parents.

Maternal parent	Total progeny	Class (weight in lb/hill)[b]					Progeny mean[a]	CV
		0	0.1-3.0	3.1-6.0	6.1-9.0	9.1-above		
Centennial	150	7 (4.7)	108 (72.0)	31 (20.7)	3 (2.0)	1 (0.7)	1.98	88.6
L0-323	182	15 (8.2)	135 (74.2)	24 (13.2)	6 (3.3)	2 (1.1)	1.91	94.7
L9-163	159	24 (15.1)	113 (71.1)	20 (12.6)	1 (0.6)	1 (0.6)	1.51	103.1
L4-312	129	21 (16.3)	99 (76.7)	11 (8.4)	0	0	1.19	93.4
L8-343	36	7 (19.4)	29 (80.6)	0	0	0	0.69	95.6

*CV = coefficient of variation.

[1]Percentage values are enclosed in parenthesis.

[a]$LSD_{.05}$ = 0.60; $LSD_{.01}$ = 0.77 for progeny means.

[b]1 lb = 453.7 gm.

Table 11. Correlations between total weight or weight of US #1 roots with other root and vine characters in the randomly selected, 160 polycross progenies of five parents.

Characters	Total weight	Weight of US #1
Root characters:		
Total weight of roots	---	.684**
Root skin color	.205**	.166**
Root flesh color	-.161*	-.058
Weight loss in storage	.106	-.063
Sprouting in field bed	.013	-.066
Vine characters:		
Vine length	.271**	.401**
Vine diameter	.559**	.616**
Vine color	-.099	-.185*
Internode length	.258**	.291**
Number of branches	.275**	.301**
Young foliage color	-.110	-.093
Leaf shape	.200**	.139
Leaf vein color	-.121	-.177*
Petiole length	.021	-.116

*Denotes that the correlation coefficient is statistically significant at the .05 level.

**Denotes that the correlation coefficient is statistically significant at the .01 level.

variance of 0.186 and for total fleshy roots it was 0.397. These genetic variances are also presented as percent of the mean (genetic coefficient of variation). The genetic coefficient of variation for the weight of US #1 roots in all the polycross progenies was 51.53% and for the weight of total fleshy roots, it was 38.89%. The character for weight of US #1 roots has an estimated heritability value of 0.273 and weight of total fleshy roots has an estimated heritability of 0.241 which are not high but show that selection can be practiced. When expected gain from selection was computed, as shown in Table 15, weight of US #1 roots has the potential of giving a gain of 28.97% and for weight of total fleshy roots there is a potential of gaining 19.31%.

As noted above, total weight of fleshy roots was positively correlated with skin color indicating that increasing color intensity from cream to purple is associated with increasing yield of total roots. But total weight of fleshy roots is negatively correlated with flesh color with a correlation coefficient of -0.161. Weight of US #1 root is also positively correlated with root skin color but there was no significant correlation between weight of US #1 roots and flesh color. Both weight of US #1 roots and weight of total roots are positively correlated with vine length, vine diameter, internode length, and number of branches. Weight of total fleshy roots was not significantly correlated with vine color and weight of US #1 roots was negatively correlated. Weight of total fleshy roots was positively correlated with leaf shape, that is, more perfect heart-shaped leaf is associated with higher yield of total fleshy roots, but weight of US #1 roots was not significantly correlated with leaf shape. Weight of total fleshy roots was not significantly correlated with leaf vein color and weight of US #1 roots was negatively correlated with leaf vein color (Table 11).

Weight Loss in Storage and Sprouting in Field Bed (1979)

Data in Table 12 show that of the 40 seedlings randomly selected from the 'Centennial' parent, 7.5% did not have any measurable weight loss and 70.0% had lower than 25% weight loss. Of the 'LO-323' progeny, 5.0% of the seedling had no appreciable weight loss and 65% had a weight loss lower than 25%. In terms of progeny means, 'L9-163' seedlings had the lowest weight loss and 'L4-312' progenies had the highest.

The test of plant production showed that 25.0% of 'Centennial' progeny, 32.5% of 'LO-323' progeny, 35.0% of 'L9-163' progeny and 30.0% of 'L4-312' progeny did not produce any sprouts in field bed. 'LO-323' progeny had the highest number of sprouts per root followed by the progeny of 'L4-312', 'L9-163' and 'L3-77' ('Centennial') with values of 6.38, 5.99, 4.94 and 4.65, respectively.

Table 12. Frequency and percentage[1] distribution of weight loss in storage of polycross seedling progenies of sweet potato maternal parents.

Maternal parent	Total progeny	Class[a] 1	2	3	4	5	Progeny mean[b]	CV
L3-77	40	3 (7.5)	28 (70.0)	7 (17.5)	1 (2.5)	1 (2.5)	18.3	94.6
L0-323	40	2 (5.0)	26 (65.0)	9 (20.5)	3 (7.5)	0	21.2	79.4
L9-163	40	7 (17.5)	26 (65.0)	7 (17.5)	0	0	16.8	80.6
L4-312	40	7 (17.5)	21 (52.5)	8 (20.0)	3 (7.5)	1 (2.5)	22.6	97.1

*CV = coefficient of variation.

[1]Percentage values are in parenthesis

[a]The classes represent percent weight loss excluding loss ude to rotting in storage as follows:

1 = no weight loss
2 = 0.1 to 25% weight loss
3 = 25.1 to 50% weight loss
4 = 50.1 to 75% weight loss
5 = 75.1 to 100% weight loss

[b]ANOV shows no significant differences between progeny means.

Table 13. Frequency and percentage[1] distribution of number of sprouts per root of polycross seedling progenies of four sweet potato maternal parents.

Maternal parent	Total progeny	Class[a]					Progeny mean[b]	CV
		1	2	3	4	5		
L3-77	40	10 (25.0)	24 (60.0)	5 (12.5)	0	1 (2.5)	4.65	115.2
L0-323	40	13 (32.5)	15 (37.5)	8 (20.0)	1 (2.5)	3 (7.5)	6.38	124.4
L9-163	40	14 (35.0)	14 (35.0)	10 (25.0)	2 (5.0)	0	4.94	119.1
L4-312	40	12 (30.0)	13 (32.5)	11 (27.5)	4 (10.0)	0	5.99	102.9

*CV = coefficient of variation.

[1]Percentage values are ecnlosed in parenthesis.

[a]Classes denotes the following:

1 = No sprout produced
2 = 0.1 to 8 plants per root
3 = 8.1 to 16 plants per root
4 = 16.1 to 24 plants per root
5 = 24.1 to 32 plants per root

[b]ANOV shows no significant difference between progeny means.

Data in Table 15 show that there was no genetic variance estimate from this experiment for weight loss in storage. A genetic variance for weight loss, was detected in this particular experiment therefore all the observed variances were attributed to environmental and/or error variance. In the plant production test, genetic variance detected was very low and heritability was 0.057 giving an expected gain of 0.81% which is very low.

Data in Table 14 show the estimated correlation coefficients between weight loss in storage or sprouting in field bed with other root and vine characters of several parental progenies. None of the correlation coefficient values were statistically significant for weight loss with any other root or vine character. For sprouting in field bed, a negative correlation with flesh root color was observed showing that increasing flesh color of fleshy roots from cream to deep orange is associated with decreasing sprouting in a field bed. None of the other root and vine characters were significantly correlated with sprouting.

Other Root and Vine Characters (1979)

Number of US #1 roots and number of total fleshy roots may also be an important consideration in selecting for

Table 14. Correlations between weight loss in storage or sprouting in field bed and other root and vine characters in the 160 polycross progenies of five parents.

Characters	Weight loss	Sprouting in bed
Root characters:		
Weight of US #1 roots	.106	-.013
Number of US #1 roots	.129	.002
Root skin color	-.142	-.038
Root flesh color	.021	-.160*
Sprouting in field bed	-.068	
Vine characters:		
Vine length	-.022	.009
Vine diameter	-.075	-.054
Vine color	.069	-.003
Internode length	-.104	-.047
Number of branches	-.093	-.015
Young foliage color	-.103	.039
Leaf shape	.026	-.086
Leaf vein color	-.029	-.115
Petiole length	.053	.050

*Denotes that the correlation coefficient is statistically significant at the .05 level.

Table 15. Mean, genetic variance, genetic coefficient of variation (CV), heritability, and expected gain from selection for some root characters in sweet potato.

Characters	Mean	Genetic variance	Genetic CV	Heritability	Expected gain from selection*
No. of US #1 roots	1.477	0.141	25.42	0.202	10.58
Weight of US #1 roots (lb/hill)[a]	0.837	0.186	51.53	0.273	28.97
No. of total fleshy roots	5.092	1.133	20.90	0.290	12.49
Weight of total fleshy roots (lb/hill)	1.620	0.397	38.89	0.241	19.31
Root skin color	3.337	0.037	5.76	0.131	1.55
Root flesh color	5.287	2.666	30.88	0.046	2.93
Weight loss in storage (%)	19.750	-3.089	-----	0.000	0.00
Sprouting in field bed (no. of plants/root)	5.496	0.604	14.14	0.057	0.81

*Expected gain from selection is presented as percent of the mean and calculated based on an assumed selection of the top 5% of the population following the method of Burton and Devane (6).

[a]1 lb = 453.7 gm.

increased yield. Data for this experiment, however, show that genetic variance, heritability, and expected gain from selection for these traits were low (Table 15).

In Table 16 are shown the data for several vine characters in the sweet potato. Estimates of heritability for vine length, vine diameter, young foliage color, leaf shape and petiole length were all high with values of 0.562, 0.695, 0.804 and 0.669, respectively. Heritability estimates for vine color, number of branches and leaf vein color were low.

Study 2. A Comparison of Sweet Potato Advanced Cultivars

In 1978, 16 advanced seedlings (cultivars) and four recommended sweet potato cultivars as checks were evaluated for yield, dry matter content, weight loss in storage at two temperature regimes, organoleptic qualities, sprouting in field bed and others. Planting was done at two locations. Of these 16 advanced seedlings, seven were selected for further testing in 1979 with the four standard checks. The same data were collected in 1979 as in 1978. The following sections deal with the results of these tests.

Advanced Yield Tests

The yield in weight of roots per hectare for the 20 cultivars tested in 1978 are presented in Table 17. The highest

Table 16. Mean, genetic variance, genetic coefficient of variation (CV), heritability, and expected gain from selection for some vine characters in sweet potato.

Characters	Mean	Genetic variance	Genetic CV	Heritability	Expected gain from selection*
Vine length	38.206	98.588	25.53	0.562	29.63
Vine diameter	6.701	1.028	15.11	0.95	29.58
Vine color	2.517	0.053	9.15	0.108	2.04
Internode length	5.551	4.162	36.75	0.207	15.67
Number of branches	5.631	0.415	11.44	0.096	2.26
Young foliage color	1.575	0.202	28.54	0.695	40.86
Leaf shape	4.954	0.634	17.89	0.804	29.63
Leaf vein color	2.165	0.045	9.80	0.091	1.84
Petiole length	20.629	5.900	11.77	0.669	16.22

*Expected gain from selection is presented as percent of mean and calculated based on an assumed selection of the top 5% of the population following the method of Burton and Devane (6).

Table 17. Mean yield of sweet potato cultivars as an average of two locations in 1978[a].

Cultivar	Marketable roots (metric ton per hectare)			
	US #1	US #2	Jumbo	Total
Centennial (ck)	14.81	3.23	0.06	18.10
Jewel (ck)	10.66	1.65	0.61	12.92
Jasper (ck)	7.74	0.79	0.12	8.65
Porto Rico (ck)	11.27	3.35		14.62
L0-323	12.37	1.88	4.57	18.82
L4-62	14.87	2.98	0.91	18.76
L4-112	7.19	4.14		11.33
L4-131	9.63	2.44		12.07
L5-5	12.25	1.71	0.12	14.08
L5-150	10.30	1.10	0.99	13.39
L5-36	14.38	3.23		17.61
L5-40	11.27	3.66		14.93
L5-42	3.11	2.86		5.97
L3-151	9.99	2.44		12.43
L3-186	5.12	2.01		7.13
L0-360	6.40	1.95		8.33
L5-6	7.13	2.50		9.63
L5-19	11.82	2.86		14.68
L4-312	4.27	1.83		6.10
L5-51	5.48	1.77		7.25
LSD 0.05	2.01	0.72		2.20

[a]Mean of eight replications.

yielding cultivars in US #1 roots were 'L4-62' and 'L5-36' with yield values of 14.87 and 14.38 tons per hectare, respectively, which are comparable to the yields of 'Centennial' ('L3-77') and higher than the yields of 'Jewel', 'Jasper' and 'Porto Rico'. 'LO-323' had the highest yield of Jumbo roots of 4.57 tons per hectare. The marketable yield (Jumbos + US #1 + US #2) of 'LO-323' was as high as 'L4-62' and 'Centennial' with yields of 18.82, 18.76 and 18.10 tons per hectare, respectively. 'L4-36' did not produce any Jumbo roots so that its yield of total marketable roots was numerically though not significantly less than the yields of the above three cultivars. The lowest yielding cultivars in total marketable roots were 'L5-42', 'L4-312', 'L3-186', 'L5-51' and 'LO-360' with yields of 5.97, 6.10, 7.13, 7.25 and 8.33 tons per hectare, respectively. The highest yielding cultivars in US #2 roots were 'L4-112' and 'L5-40' with 4.14 and 3.66 tons per hectare, respectively.

The mean number of roots per hill of each cultivar are shown in Table 18. 'Centennial' had the highest mean of 2.95 US #1 roots per hill. 'L5-36' and 'L5-5' were comparable to 'Centennial' as shown in Table 18. 'Porto Rico', 'LO-323', 'L4-62', 'L5-5' and 'L5-40' had similar number of US #1 roots per hill of 2.15, 2.03, 2.22, 2.43 and 2.24, respectively. 'L4-112' had the highest mean of 2.67 of US #2 roots per hill as shown in Table 18. 'L5-42' was comparable to 'L4-112' in number of US #2 roots.

Results of the 1979 yield test are shown in Tables 19 and 20. 'LO-323' had the highest yield of US #1 roots of 22.97 tons per hectare followed by 'L4-62' and 'L5-150' with 19.74 and 18.04 tons per hectare, respectively. These yields are comparable to the US #1 root yields of 'Centennial', 'Jewel', 'Jasper' and 'Porto Rico' with 18.40, 20.47, 17.92 and 17.18 tons per hectare, respectively as shown in Table 19. Also shown in Table 19 is the 'LO-323', 'L4-62' and 'L5-5 in yield of Jumbo roots of 12.55, 16.21 and 13.41 tons per hectare, respectively. Among the standard checks, 'Jasper' had the highest yield of Jumbo roots of 4.63 tons per hectare. Because of the earliness character as shown by the high Jumbo root yield, 'LO-323' and 'L4-62' had very high total marketable root yields of 39.72 and 38.83 tons per hectare, respectively and were significantly higher than 'Centennial', 'Jewel', 'Jasper' and 'Porto Rico' as shown in Table 19. The cultivars giving a relatively low total marketable root yield were 'L4-131', 'L5-150' and 'L4-112' with 13.10, 24.14 and 24.38 tons per hectare, respectively.

There were no significant differences in number of US #1 roots among most of the cultivars in 1979 as shown in Table 20. However, cultivar 'L4-112' had the highest number of US #2 (canners) roots with a mean of 3.71 per hill; whereas, all the other cultivars had less than three roots per hill.

The two-year mean yield for the eleven cultivars tested both in 1978 and 1979 are shown in Tables 21 and 22. 'L4-62' had the highest yield in weight of US #1 roots and of total marketable roots of 16.48 and 28.00 tons per hectare, respectively as shown in Table 21. This yield in weight of US #1 roots of 'L4-62' was numerically but not significantly higher than that of 'Centennial' but in total marketable roots, 'L4-62' had a significantly higher yield because of the high yield of Jumbo roots. 'LO-323' had also a comparable two-year mean yield of US #1 Jumbo grade and total marketable roots as 'L4-62'. These data indicate that 'L4-62' and 'LO-323' should be considered as early cultivars. In the national sweet potato variety trials conducted at various experiment stations throughout the United States, 'LO-323' had also been shown to give high yields of Jumbo and total marketable roots (2, 3, 37, 47, 101).

In number of roots per hill, the two-year mean data show that 'L4-112' had numerically the highest number of US #2 and total marketable roots as shown in Table 22.

In Table 23 data are shown for the analysis of variances for the two-year data expressed as weight or number of US #1, US #2, Jumbo grade and total marketable roots.

The F-values for cultivar X location interactions were significant at the 0.01 level for the following independent variables: weight of US #1 roots, number of total marketable roots per hill and weight of total marketable roots. For the mean number of US #1 roots per hill, the cultivar X location interaction was significant at the 0.05 level and for the mean weight of US #2 roots and mean number of US #2 roots per hill, the cultivar X location interaction was not significant. These data show that sweet potato yield of US #1 roots and total marketable roots can vary from location to location depending on weather conditions and other factors.

Several workers (59, 61, 84, 85, 87) have reported on the large variability of results of experiments with sweet potatoes conducted from location to location and from year to year. The variability can be minimized in many cases by conducting the same experiment at several locations and years and using improved statistical techniques. One characteristic

Table 18. Mean number of roots per hill of sweet potato cultivars as an average of two locations in 1978[a].

Cultivar	Marketable roots (number of roots per hill) US #1	US #2	Jumbo	Total
Centennial (ck)	2.95	1.80	0.005	4.76
Jewel (ck)	1.98	0.88	0.025	2.88
Jasper (ck)	1.20	0.58	0.005	1.78
Porto Rico (ck)	2.15	1.70		3.85
LO-323	2.03	0.97	0.014	3.01
L4-62	2.22	1.73	0.045	4.00
L4-112	1.67	2.67		4.34
L4-131	1.78	1.51		3.29
L5-5	2.43	1.11		3.54
L5-150	1.57	0.67		2.24
L5-36	2.55	1.81		4.36
L5-40	2.24	1.92		4.16
L5-42	0.86	2.05		2.91
L3-151	1.93	1.35		3.28
L3-186	1.12	1.10		2.22
LO-360	1.38	1.32		2.70
L5-6	1.64	1.37		3.02
L5-19	2.08	1.23		3.31
L4-312	1.09	1.11		2.20
L5-51	0. 6	1.12		2.08
LSD 0.05	0.59	0.64		0.95

[a]Mean of eight replications.

Table 19. Mean yield of sweet potato cultivars in 1979[a].

Cultivar	Marketable roots (metric ton per hectare) US #1	US #2	Jumbo	Total
Centennial (ck)	18.40	5.30	0.91	24.61
Jewel (ck)	20.47	5.30	0.06	25.83
Jasper (ck)	17.92	4.87	4.63	27.42
Porto Rico (ck)	17.18	5.00	1.83	24.01
LO-323	22.97	4.20	12.55	39.72
L4-62	19.74	2.86	16.21	38.81
L4-112	16.70	7.68		24.38
L4-131	8.59	4.51		13.10
L5-5	10.66	3.96	13.41	28.03
L5-150	18.04	3.66	2.44	24.14
L5-36	17.92	8.53		26.45
LSD 0.05	2.39	0.99		2.59

[a]Mean of four replications.

Table 20. Mean number of roots per hill of sweet potato cultivars in 1979[a].

Cultivar	Marketable roots (number of roots per hill)			
	US #1	US #2	Jumbo	Total
Centennial (ck)	2.62	1.97		4.59
Jewel (ck)	2.81	2.13	0.05	4.99
Jasper (ck)	1.91	1.33	0.24	3.48
Porto Rico (ck)	2.30	1.53	0.09	3.92
L0-323	2.57	1.48	0.54	4.59
L4-62	2.47	1.03	0.49	3.99
L4-112	2.75	3.71		6.46
L4-131	1.36	2.35		3.71
L5-5	2.31	2.40	0.62	5.33
L5-150	2.33	1.42	0.09	3.84
L5-36	2.60	2.06		4.66
LSD 0.05	0.51	0.50		0.75

[a]Mean of four replications.

Table 21. Mean yield of sweet potato cultivars as an average of 1978 and 1979[a].

Cultivar	Marketable roots (metric ton per hectare)			
	US #1	US #2	Jumbo	Total
Centennial (ck)	16.01	3.94	0.40	20.43
Jewel (ck)	13.92	2.87	0.33	17.12
Jasper (ck)	11.11	2.16	2.37	15.64
Porto Rico (ck)	13.27	3.91	0.91	18.09
L0-323	15.91	2.44	8.56	26.91
L4-62	16.48	2.96	8.56	28.00
L4-112	10.37	5.36		15.73
L4-131	10.52	3.15		13.67
L5-5	11.45	2.44	6.70	20.59
L5-150	12.90	1.95	1.22	16.07
L5-36	15.14	5.01		20.15
LSD 0.05	3.13	1.34		3.59

[a]Mean of four replications each year.

Table 22. Mean number of roots per hill of sweet potato cultivars as an average of 1978 and 1979[a].

Cultivar	Marketable roots (number of roots per hill) US #1	US #2	Jumbo	Total
Centennial (ck)	2.84	1.86		4.70
Jewel (ck)	2.26	1.32	0.04	3.58
Jasper (ck)	1.44	0.83	0.12	2.39
Porto Rico (ck)	2.20	1.65	0.04	3.89
L0-323	2.22	1.14	0.28	3.64
L4-62	2.31	1.50	0.27	4.08
L4-112	2.03	2.97		5.00
L4-131	1.65	1.79		3.44
L5-5	2.81	1.31	0.31	4.43
L5-150	1.79	0.92	0.04	2.75
L5-36	2.59	2.06		4.65
LSD 0.05	0.57	0.54		0.80

[a]Mean of four replications each year.

Table 23. Analysis of variance for location (or year), cultivars and location X cultivar interaction for yield tests in 1978 and 1979.

Source of variance	Degrees of freedom	Sums of squares	Mean squares	F-value	CV
Dependent variable: Weight of US #1 roots					
Location	2	3739.5	1869.7	61.42**	
Rep (location)	9	196.5	21.8		
Cultivar	10	2059.0	205.9	6.76**	
Cultivar X location	20	1683.4	84.1	2.76**	
Error	90	2739.9	30.4		24.57
Dependent variable: Weight of total marketable roots					
Location	2	11348.6	5674.3	141.67**	
Rep (location)	9	391.3	43.5		
Cultivar	10	4853.7	485.4	12.12**	
Cultivar X location	20	2931.4	146.6	3.66**	
Error	90	3604.8	40.1		21.06
Dependent variable: Number of US #1 roots					
Location	2	3376.6	1688.3	11.16**	
Rep (location)	9	614.8	68.3		
Cultivar	10	9741.8	974.2	6.44**	
Cultivar X location	20	5821.5	291.1	1.92**	
Error	90	13619.7	151.3		28.03

Table 23. Analysis of variance for location (or year), cultivars and location X cultivar interaction for yield tests in 1978 and 1979...(continued)

Source of variance	Degrees of free-dom	Sums of squares	Mean squares	F-value	CV
Dependent variable: Number of total marketable roots					
Location	2	13253.0	6626.5	22.2**	
Rep (location)	9	1543.0	171.4		
Cultivar	10	32449.6	3214.9	10.86**	
Cultivar X location	20	14106.5	705.3	2.36**	
Error	90	26881.9	298.7		22.7
Dependent variable: Number of US #2 roots					
Location	2	3202.6	1601.3	11.29**	
Rep (location)	9	1329.4	147.7		
Cultivar	10	17442.2	1744.2	12.29**	
Cultivar X location	20	4424.9	221.2	1.56^{ns}	
Error	90	12769.0	141.9		37.7
Dependent variable: Weight of US #2 roots					
Location	2	611.9	306.0	54.6**	
Rep (location)	9	35.4	3.9		
Cultivar	10	414.7	41.5	7.40**	
Cultivar X location	20	185.3	9.3	1.65^{ns}	
Error	90	504.0	5.6		43.8

*Significant at the 0.05 level.

**Significant at the 0.01 level

of the sweet potato which contributes greatly to the variability of experimental results is the differences in earliness to form or set fleshy roots. Since this type of earliness is oftentimes not correlated with physiological earliness or maturity, it has been suggested, especially for the tropics that data be taken and comparisons made between cultivars for early, medium, and late harvests (95).

Dry Matter Content at Harvest and After Storage

In Table 24 are shown the percentage dry matter content (% of fresh weight) of fleshy roots of the 20 sweet potato cultivars in the 1978 crop. 'Porto Rico' had the highest dry matter content of 27.4% at harvest and after storage for 22 weeks at 60°F (15.5°C) it was 27.77% and at 70°F (21.1°C) it was 27.3%. None of the advanced seedlings had a dry matter content as high as that of 'Porto Rico'. 'L3-186' had the highest dry matter content of 25.99% at harvest among the advanced seedlings. The dry matter contents of 'L4-131' was 25.61 which was comparable to that of 'L3-186'. The lowest dry matter content was recorded for 'L4-62' with 17.35% at harvest, 16.27% at the end of 22 weeks storage at 60°F (15.5°C) and 14.88 after storage at 70°F (21.1°C).

In the 1979 test, 'Porto Rico' again had the highest dry matter content at harvest with 28.5% and after storage at 60°F (15.5°C) it was 28.6% and at 70°F (21.1°C) it was 28.2%

as shown in Table 25. At harvest, the dry matter content of 'Centennial' (27.7%) was not significantly different from that of 'Porto Rico'. After 22 weeks storage at 60°F (15.5°C), the dry matter content of 'Centennial' was still comparable to that of 'Porto Rico', but 'Centennial' roots stored at 70°F (21.1°C) had significantly lower dry matter content than 'Porto Rico' under the same storage conditions. 'L4-131' had 26.1%, 'L4-112' had 24.9% and 'L5-5' had 24.8% dry matter contents at harvest. The lowest dry matter content was found in 1979, as in 1978, to be in 'L4-62' with 17.9% at harvest, 16.8% at the end of storage at 60°F (15.5°C) and 15.8% at 70°F (21.1°C).

In Figure 1 is shown the mean dry matter content as an average of all cultivars in the 1978 crop for sweet potatoes at harvest time stored at 60°F (15.5°C) and at 70°F (21.1°C). The dry matter content at harvest as an average of the 20 cultivars was numerically but not significantly higher than at 60°F (15.5°C). Roots of the cultivars stored at 70°F (21.1°C) had significantly lower dry matter content than roots at harvest and at 60°F (15.5°C) as shown in Figure 1.

In the 1979 crop, the dry matter content as an average of 11 cultivars at harvest was practically the same as at the end of 22 week storage at 60°F (15.5°C) as shown in Figure 2. As in 1978, the dry matter content of roots stored at 70°F (21.1°C) were significantly lower than those at harvest and at 60°F (15.5°C).

Table 24. Percentage dry matter content of fleshy roots of sweet potato cultivars at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) in the 1978 crop[b].

Cultivar	At harvest	After 22 weeks in storage	
		60°F (15.5°C)	70°F (21.1°C)
Centennial (ck)	26.79	24.55	25.84
Jewel (ck)	23.00	23.13	21.89
Jasper (ck)	22.10	19.09	19.22
Porto Rico (ck)	27.38	27.77	27.31
L0-323	20.03	19.92	19.34
L4-62	17.35	16.27	14.88
L4-112	24.10	24.39	22.38
L4-131	25.61	24.24	22.43
L5-5	23.69	23.76	21.02
L5-150	23.32	22.50	22.38
L5-36	22.09	20.84	19.92
L5-40	22.59	21.87	20.51
L5-42	23.39	25.46	23.70
L3-151	24.47	24.59	24.32
L3-186	25.99	24.86	26.01
L0-360	20.46	21.55	18.99
L5-6	23.83	25.72	23.76
L5-19	23.24	23.67	22.78
L4-312	22.04	23.13	-----
LSD 0.05	0.91	1.54	1.54

[a]Mean of two replications with two samples taken from three roots in each replication.

Table 25. Percentage dry matter content of fleshy roots of sweet potato cultivars at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) in the 1979 crop .

Advanced seedling or check cultivar	At harvest	After 22 weeks in storage (percent of fresh weight) 60°F (15.5°C)	70°F (21.1°C)
Centennial (ck)	28.6	30.3	25.7
Jewel (ck)	26.4	26.9	26.4
Jasper (ck)	23.4	23.4	21.7
Porto Rico (ck)	29.6	29.5	29.1
L0-323	20.8	23.3	18.3
L4-62	18.5	17.4	16.8
L4-112	25.7	26.9	25.5
L4-131	26.6	26.4	25.8
L5-5	25.9	27.1	24.5
L5-150	25.0	26.3	24.4
L5-36	22.6	24.3	21.3
LSD 0.05	0.77	1.46	1.46

[a]Mean of two replications with two samples taken from three roots in each replication.

Table 26. Percentage dry matter content of fleshy roots of sweet potato cultivars at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of the 1978 and 1979 crops.

Cultivar	harvest	After 22 weeks in storage 60°F (15.5°C)	70°F (21.1°C)
Centennial (ck)	27.7	27.4	25.7
Jewel (ck)	24.7	25.0	24.1
Jasper (ck)	22.7	21.2	20.4
Porto Rico (ck)	28.5	28.6	28.2
L0-323	20.4	21.6	18.8
L4-62	17.9	16.8	15.8
L4-112	24.9	25.6	23.9
L4-131	26.1	25.3	24.1
L5-5	24.8	25.4	22.7
L5-150	24.1	24.4	23.4
L5-36	22.3	22.5	20.6
LSD 0.05	0.83	1.49	1.52

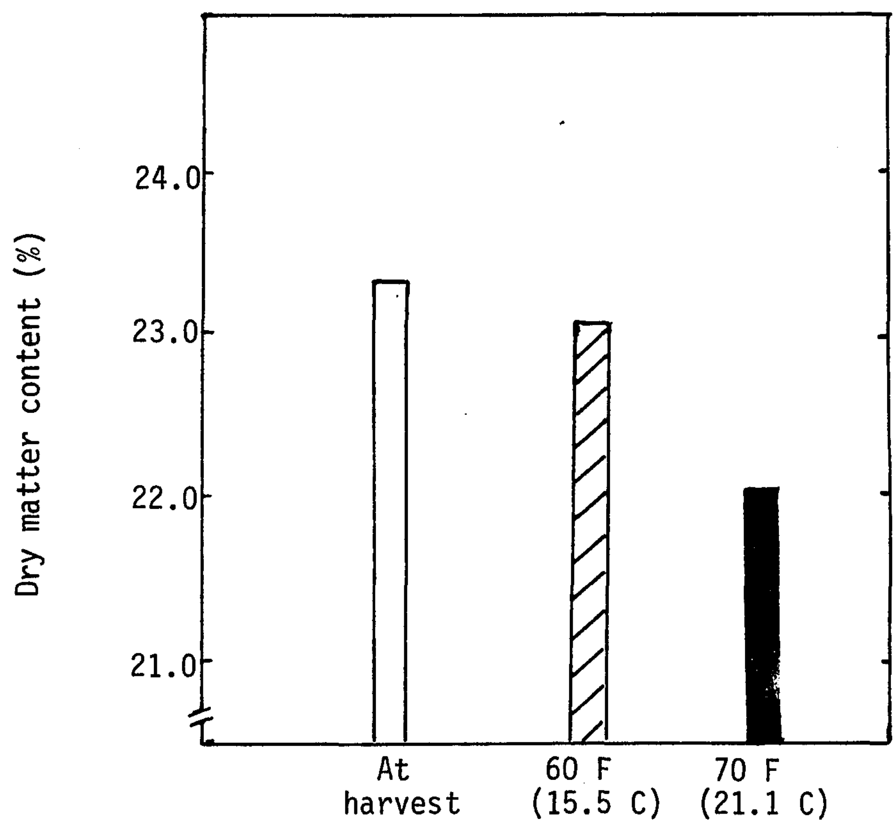
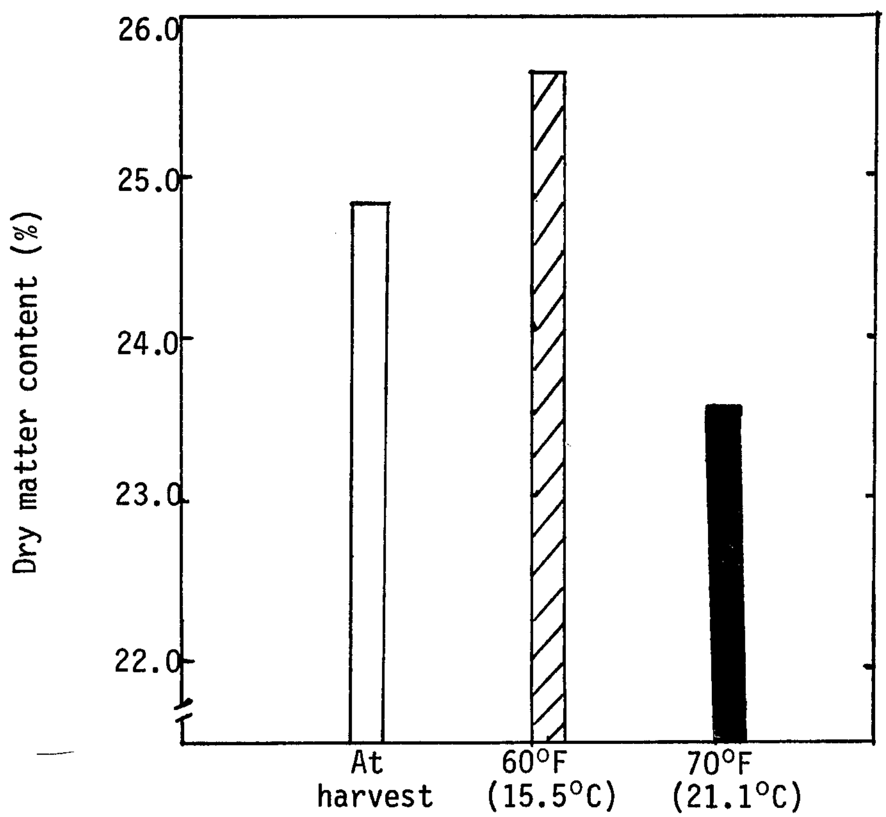


Figure 1. Percentage dry matter content of sweet potato fleshy roots at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 20 cultivars in the 1978 crop.



Fiugre 2. Percentage dry matter content of sweet potato fleshy roots at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 11 cultivars in the 1979 crop.

The dry matter content as an average of 11 cultivars and as a mean of the 1978 and 1979 crops are shown in Figure 3. Practically the same trend was observed as in both years.

Weight Loss in Storage

The weight losses of US #1 roots after curing and at four-week intervals in storage at 60°F (15.5°C) in the 1978 crop are presented in Table 27. No significant differences among cultivars were observed in weight loss after curing. The losses in weight after curing ranged from 3.09% by 'L5-150' to a high of 6.74% by 'L4-312' roots with an average of 4.60% for the 20 cultivars. At the end of 22 weeks storage at 60°F, the cultivars with the least weight losses were 'L5-150', 'L5-51', 'L4-131' and 'L5-5' with losses of 10.25%, 12.79%, 12.89% and 13.12%, respectively. The highest weight losses were found to be by 'L5-6', 'L5-42, 'L4-312 and 'L4-62' with weight losses of 27.04%, 24.05%, 23.36% and 20.34%, respectively. Although the cultivars differed in the magnitude of increase in weight loss, all cultivars continued to lose weight in storage at 60°F (15.5°C) as shown in Table 27.

In Table 28 are shown the percentage weight loss of fleshy roots of sweet potato cultivars after curing and at four-week intervals in storage at 70°F (21.1°C) in the 1978 crop. No significant differences were observed between cultivars

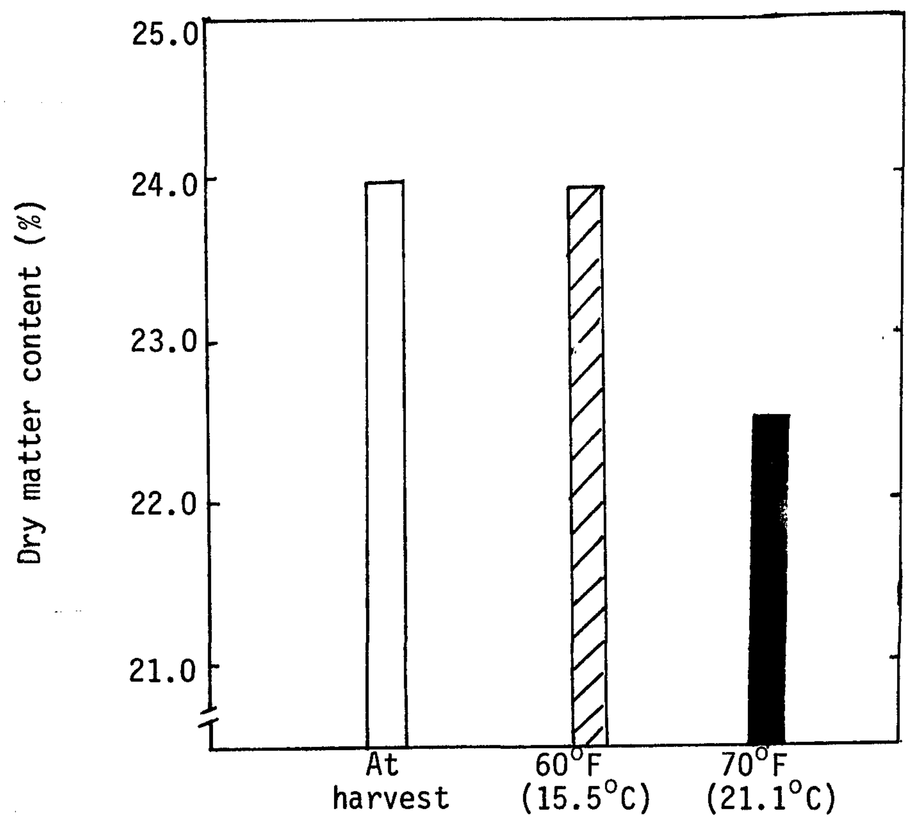


Figure 3. Percentage dry matter content of sweet potato fleshy roots at harvest and after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 11 cultivars in the 1978 and 1979 crops.

in weight loss after curing. After 20 weeks in storage, 'L4-312' had the highest weight loss of 45.18%, followed by 'L5-6' with 29.16% and by 'L5-42' with 25.87%. 'L5-36' had the lowest weight loss of 14.39%. Cultivars with the least weight losses in 60 F (15.5 C) storage, such as 'L5-150' and 'L5-51' (Table 27) were not necessarily the cultivars with the least weight loss at 70°F (21.1°C) storage (Table 28).

The mean weight losses at four-week intervals as an average of all cultivars in the 1978 test are shown in Figure 4. In general, the rate of increase in percentage weight loss is greatest after curing up to four weeks in storage. Previous studies (65) show a sigmoid curve when weight loss is plotted against time since there is an initial fast rate of weight loss at the start of storage followed by a slower rate, then again a fast rate and finally another slow rate. Results of the present test agree with the above observation of Kushman and Deonier (65) with the exception of the last stage of the sigmoid curve when a slow rate is supposed to take place. In general, there was greater weight loss for the cultivars at 70°F (21.1°C) storage than at 60°F (15.5°C) storage.

In the 1979 test, no significant differences in percentage weight losses were observed among the cultivars after curing and after 22 weeks at 60°F (15.5°C) storage as shown in Table 29. In the 70°F (21.1°C) storage, 'L0-323'

Table 27. Percentage weight loss of fleshy roots of sweet potato cultivars after curing and at four-week intervals in storage at 60°F (15.5°C) in the 1978 crop[a].

Cultivar	After curing	Weeks in storage 4	8	12	16	20
Centennial	4.81	8.07	8.45	11.19	12.56	15.08
Jewel	4.49	7.76	7.84	10.58	12.64	14.51
Jasper	5.95	10.19	11.69	15.42	17.78	20.71
Porto Rico	6.00	9.47	10.88	12.21	15.13	17.89
LO-323	4.47	8.57	9.94	13.69	16.36	19.24
L4-62	5.65	9.57	11.07	14.24	17.01	20.34
L4-112	4.66	8.19	8.92	12.14	13.58	15.76
L4-131	4.57	4.57	7.56	7.69	11.05	12.89
L5-5	3.63	6.70	7.03	9.06	11.21	13.12
L5-150	3.09	5.06	5.06	7.35	8.56	10.35
L5-36	3.87	6.71	7.48	10.59	14.42	14.78
L5-40	5.66	8.83	10.20	12.78	14.44	16.74
L5-42	5.10	9.31	12.78	16.37	17.88	24.05
L3-151	5.59	8.28	9.15	12.27	14.23	16.56
L3-186	4.94	7.96	8.79	11.07	11.81	14.59
LO-360	4.01	6.64	7.31	9.64	11.05	13.16
L5-6	6.19	12.17	14.85	19.19	24.82	27.04
L5-19	4.94	9.02	9.94	13.34	15.67	19.20
L4-312	6.74	11.76	12.96	17.57	18.66	23.36
L5-51	4.81	8.39	8.69	10.24	11.21	12.79
LSD 0.05	ns			2.12		2.25

[a]Mean of four replications.

Table 28. Percentage weight loss of fleshy roots of sweet potato cultivars after curing and at four-week intervals in storage at 70°F (21.1°C) in the 1978 crop[a].

Cultivar	After curing	Weeks in storage 4	8	12	18	20
Centennial	3.95	8.75	9.54	12.05	15.09	18.04
Jewel	3.85	7.73	7.65	10.03	12.91	17.31
Jasper	4.36	8.50	9.51	11.89	14.63	17.06
Porto Rico	4.46	8.40	9.15	12.21	14.67	17.05
LO-323	5.66	11.66	13.15	15.15	19.03	22.55
L4-62	5.49	10.64	12.39	16.27	21.76	26.08
L4-112	3.83	8.47	9.74	12.90	15.97	18.52
L4-131	3.91	8.66	9.80	12.83	15.37	17.56
L5-5	4.08	7.90	8.94	11.09	13.86	15.59
L5-150	3.80	7.39	8.35	11.01	14.82	16.99
L5-36	3.47	6.72	7.42	9.90	12.61	14.39
L5-40	3.42	7.21	9.30	10.49	12.72	14.88
L5-42	4.73	11.29	15.74	18.29	20.90	25.87
L4-151	5.15	9.36	11.13	14.59	17.65	20.39
L3-186	2.86	8.09	10.47	13.93	15.22	17.71
LO-360	4.29	8.91	10.62	12.32	14.03	16.16
L5-6	5.91	11.31	16.12	20.67	24.89	29.16
L5-19	3.99	8.20	9.12	11.91	15.84	20.24
L4-312	8.96	17.49	16.59	30.68	37.48	45.18
L5-51	4.18	9.64	10.92	14.19	16.72	19.22
LSD 0.05	ns			2.12		2.25

[a]Mean of four replications.

Table 29. Percentage weight loss of fleshy roots of sweet potato cultivars after curing and at two-week intervals in storage at 60°F (15.5°C) in the 1979 crop[a].

Cultivar	After curing	Weeks in storage									
		2	4	6	8	10	12	14	16	18	20
Centennial	4.76	6.12	6.80	7.48	8.16	8.16	8.50	8.84	11.22	11.56	12.24
Jewel	5.56	6.90	7.23	7.86	8.53	8.68	9.01	9.34	11.31	11.50	11.50
Jasper	2.64	4.14	4.61	5.07	5.95	6.12	6.73	7.04	9.01	0.29	12.62
Porto Rico	5.33	6.94	7.48	8.01	8.70	9.09	9.75	10.14	11.76	11.90	12.27
LO-323	5.49	7.23	7.52	8.09	8.96	9.11	9.54	10.12	11.85	11.85	12.00
L4-62	4.37	6.42	7.01	7.60	8.04	9.06	9.64	10.09	11.39	11.39	11.39
L4-112	4.58	6.45	6.83	5.56	8.32	8.32	8.50	9.09	11.38	11.38	11.38
L4-131	6.36	8.34	8.83	9.33	10.32	10.32	10.73	11.14	13.70	13.70	14.11
L5-5	4.73	6.41	6.92	7.43	7.94	8.28	8.78	9.46	11.48	11.82	12.83
L5-150	3.46	4.89	5.33	5.77	6.63	6.78	7.20	7.78	9.51	9.65	10.34
L5-36	5.37	7.07	7.23	7.88	8.37	8.37	9.04	9.22	10.90	10.90	10.90
LSD 0.05	ns						ns				ns

[a]Mean of two replications with 25 roots each cultivar in each replication

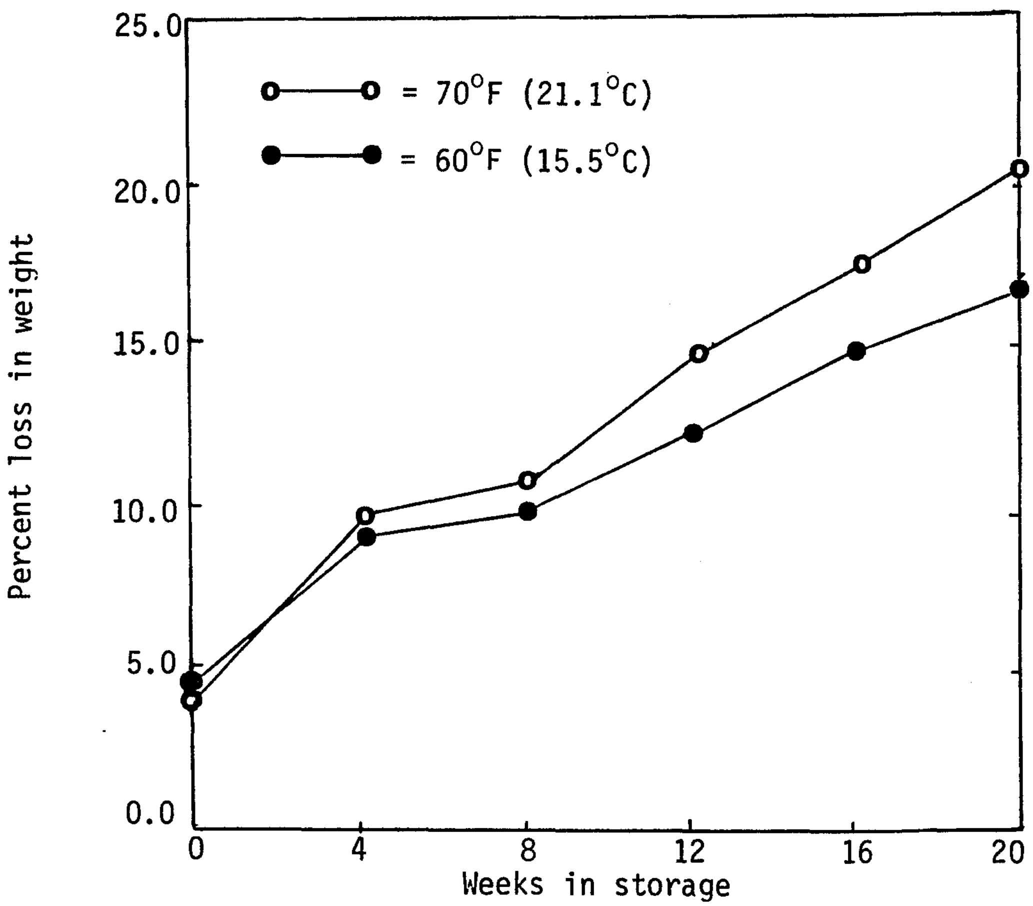


Figure 4. Percentage weight loss of sweet potato fleshy roots at four-week intervals in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 20 cultivars in the 1978 crop.

had a low weight loss of 11.84% after 22 weeks storage and this was comparable with 'Jewel' which had the lowest weight loss of 10.91% among all cultivars as shown in Table 30. 'L4-62' and 'L4-131' had the highest weight losses of 16.73% and 15.24%, respectively, after 22 weeks storage at 70°F (21.1°C) as shown in Table 30.

In Figure 5 and Table 32 are shown the percentage weight losses at 60°F (15.5°C) and 70°F (21.1°C) storage as an average of 11 cultivars for the 1979 test. The graph for the weight losses in storage at 60°F (15.5°C) and 70°F (21.1°C) both approached a sigmoid curve. There was a fast increase in weight loss at the beginning of storage followed by a slower rate from two weeks to four weeks and then another fast rate from 14 weeks to 16 weeks and again a slower rate from 16 weeks to 20 weeks.

Weight loss in storage for sweet potato fleshy roots is one of the changes brought about by the post-harvest physiological processes in the roots (94). Fleshy roots of sweet potatoes contain living tissues and undergo the processes of respiration and transpiration leading to losses in weight (22, 94).

Organoleptic Quality Tests

The organoleptic ratings for baked roots of each cultivar in the 1978 crop after storage at 60°F (15.5°C) and at 70°F (21.1°C) are shown in Tables 33 and 34. 'Porto Rico' consistently

Table 30. Percentage weight loss of fleshy roots of sweet potato cultivars after curing and at two-week intervals in storage at 70°F (21.1°C) in the 1979 crop[a].

Cultivar	After curing	Weeks in storage									
		2	4	6	8	10	12	14	16	18	20
Centennial	4.97	6.60	7.93	8.43	8.94	9.09	9.09	9.60	12.40	12.55	12.86
Jewel	5.26	6.60	7.94	8.14	8.90	8.90	8.90	9.04	10.91	10.91	10.91
Jasper	4.62	6.69	7.45	7.97	9.25	9.37	9.63	10.14	12.59	13.63	14.15
Porto Rico	5.34	7.25	8.87	9.16	10.72	10.72	11.01	11.63	13.45	13.79	13.79
LO-323	3.73	5.87	6.66	7.06	7.99	8.00	8.13	8.53	10.27	11.84	11.84
L4-62	5.30	7.78	8.76	9.39	11.58	12.07	12.07	12.39	14.58	15.04	16.73
L4-112	4.91	6.32	8.04	8.20	9.06	9.25	9.44	9.95	12.90	13.60	14.30
L4-131	5.47	7.41	8.99	9.58	10.93	11.14	11.14	11.53	14.46	14.86	15.24
L5-5	4.77	6.37	7.64	8.28	9.55	9.71	9.88	10.20	12.43	12.43	12.43
L5-150	3.74	5.44	6.59	7.18	8.49	8.91	8.91	9.63	12.37	13.54	14.08
L5-36	5.84	7.91	9.58	9.58	10.41	10.61	10.61	11.03	13.75	14.59	14.59
LSD 0.05	ns						1.01				0.985

[a]Mean of two replications with 25 roots each cultivar in a replication.

Table 31. Percentage weight loss after curing and at four-week intervals in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 1978 and 1979 crops..

Cultivar	After curing	Stored at 60°F (15.5°C)					Stored at 70°F (21.1°C)				
		4	8	12	16	20	4	8	12	16	20[a]
Centennial	4.78	7.43	8.30	9.84	11.89	13.66	8.34	9.24	10.57	13.74	15.45
Jewel	5.02	7.49	8.18	9.79	11.97	13.00	7.83	8.27	9.46	11.91	14.11
Jasper	4.29	7.40	8.82	11.07	13.39	16.16	7.97	9.38	10.76	13.61	15.60
Porto Rico	5.66	8.47	9.79	10.98	13.44	15.08	8.63	9.93	11.61	14.06	15.42
L0-323	4.98	8.04	9.45	11.61	14.10	15.62	9.16	9.82	11.64	14.65	17.19
L4-62	5.01	8.29	9.55	11.94	14.20	15.86	9.70	11.98	14.17	18.17	21.40
L4-112	4.62	7.51	8.62	10.32	12.48	13.57	8.25	9.40	11.17	14.43	16.41
L4-131	5.46	6.70	8.94	9.21	12.37	13.50	8.82	10.36	11.98	14.91	16.40
L5-5	4.18	6.81	7.48	8.92	11.34	12.97	7.77	9.24	10.48	13.14	14.01
L5-150	3.27	5.19	5.84	7.27	9.03	10.34	6.99	8.42	9.96	13.59	15.53
L5-36	4.62	6.97	7.92	9.81	12.66	12.84	8.15	8.91	10.25	13.18	14.49
LSD 0.05	ns			0.87		0.92			0.99		1.06

[a]Weeks in storage.

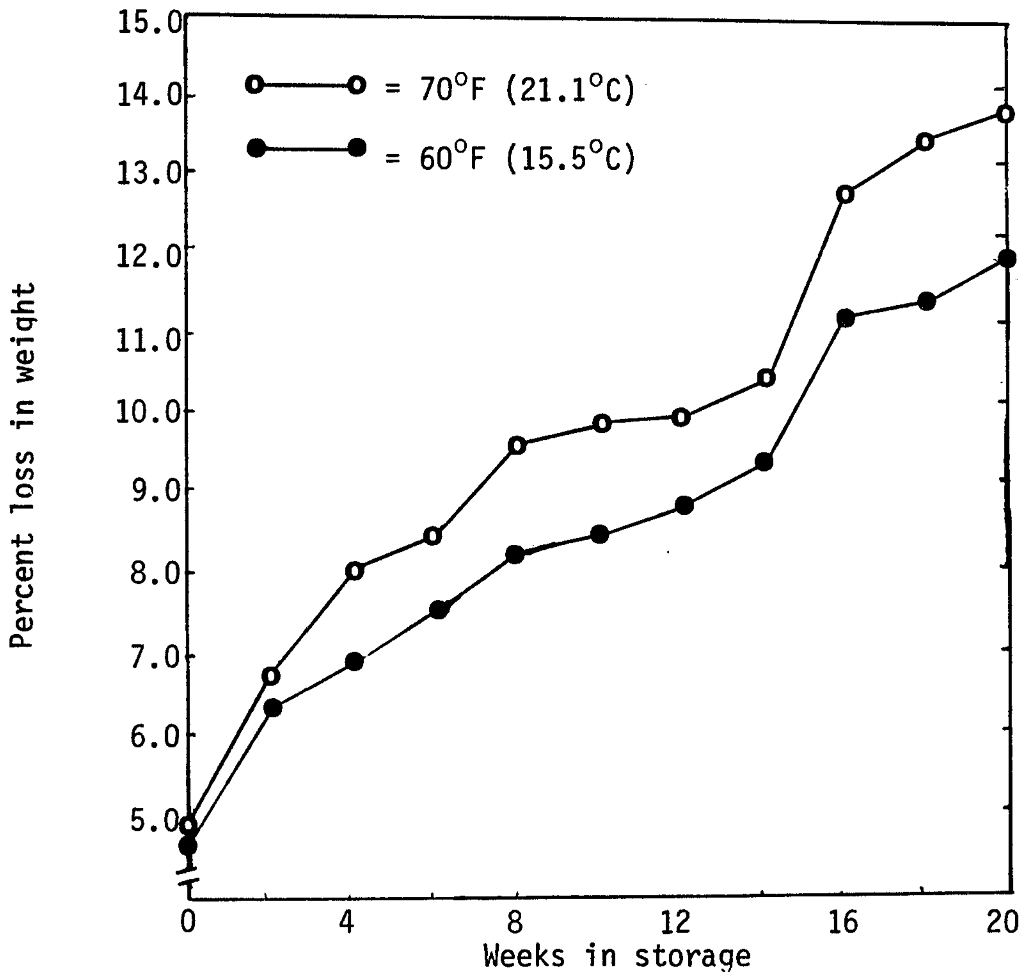


Figure 5. Percentage weight loss of sweet potato fleshy roots at four-week intervals in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 11 cultivars in the 1979 crop.

rated very low in color with a rating of 2.62 after storage at 60°F (15.5°C) and a rating of 3.25 after storage at 70°F (21.1°C) yet 'Porto Rico' still received a relatively high baking index of 6.06 for those fleshy roots stored at 60°F (15.5°C) and 6.37 for those at 70°F (21.1°C). This variety rated high on the quality factors of flavor and texture. 'LO-323', 'L4-112' and 'L4-131' had comparatively good baking indices at 60°F (15.5°C) and at 70°F (21.1°C). Generally all of the cultivars were considered acceptable in quality factors. Previous workers (12, 13, 28, 45, 46) have reported a significantly positive correlation between good orange flesh color and baking index.

In the 1979 crop tests, differences among cultivars in the baking indices were small in the 60°F (15.5°C) storage as shown in Table 35. 'L4-131' had the highest baking index of 7.17 as compared to 6.00 for 'Jewel' which had the highest baking index among the checks (Table 35). 'Porto Rico' had the lowest rating in color of 3.2 but received a relatively high baking index due to its high rating in the three other factors.

The same trend was observed with cultivars in the 1979 crop stored at 70°F (21.1°C) as shown in Table 36. 'L4-131' still had the highest baking index at 70°F (21.1°C). 'Porto Rico' was again rated low in color. All the cultivars had acceptable baking indices as shown in Table 36.

Table 32. Weight losses at 60°F (15.5°C) and 70°F (21.1°C) as an average of 20 cultivars in 1978, 11 cultivars in 1979 and cultivars as the mean of 1978 and 1979[a].

Temperature in storage	After curing	Weeks in storage 4	8	12	16	20
1978 crop:						
60°F (15.5°C)	4.60	8.15	9.50	12.44	14.90	17.09
70°F (21.1°C)	3.85	9.39	10.71	14.82	17.31	20.50
1979 crop:						
60°F (15.5°C)	4.70	6.89	8.16	8.85	11.22	11.96
70°F (21.1°C)	4.90	8.04	9.62	9.89	12.74	13.72
Mean of 1978 and 1979 crops:						
60°F (15.5°C)	4.71	7.30	8.53	10.07	11.37	13.92
70°F (21.1°C)	4.58	8.33	9.54	11.09	14.13	16.00

[a]Mean of eleven cultivars.

Table 33. Organoleptic ratings of fleshy roots of sweet potato cultivars baked after 22 weeks in storage at 60°F (15.5°C) in the 1978 crop.

Advanced seedling or cultivar	Color	Flavor	Texture	Fiber	Baking index
Centennial (ck)	6.12	6.25	6.50	6.75	6.40
Jewel (ck)	7.12	7.00	7.25	7.25	7.15
Jasper (ck)	6.00	5.87	6.00	6.75	6.15
Porto Rico (ck)	2.62	6.62	7.62	7.37	6.06
L0-323	6.75	7.37	7.37	7.12	7.19
L4-62	5.87	5.00	6.00	7.12	5.94
L4-112	6.62	6.12	6.50	7.25	6.66
L4-131	7.37	7.12	6.75	6.75	6.99
L5-5	5.75	5.75	5.50	6.25	5.81
L5-150	5.23	5.37	6.87	7.25	6.25
L5-36	6.62	5.37	5.62	6.50	6.09
L5-40	6.37	5.25	5.00	6.37	5.84
L5-42	5.75	5.00	6.50	6.25	5.81
L3-151	7.50	6.25	6.37	5.87	6.47
L3-186	6.75	6.87	7.12	7.37	7.09
L0-360	5.75	4.37	5.37	6.00	5.44
L5-6	6.37	5.75	5.75	6.62	6.31
L5-19	6.75	6.12	6.75	7.50	6.78
L4-312	4.37	6.12	6.37	6.62	6.34
L5-51	6.25	4.75	5.12	5.62	5.44
LSD 0.05	0.54	0.49	0.63	0.42	0.60

[a]Rating was from 0 to 10 with 10 representing maximum favorable expression of the character. Mean of two replications with eight raters per replication.

Table 34. Organoleptic ratings[a] of fleshy roots of sweet potato cultivars baked after 22 week storage at 70°F (21.1°C) in the 1978 crop.

Advanced seedling or cultivar	Color	Flavor	Texture	Fiber	Baking index
Centennial (ck)	7.00	6.87	7.25	7.50	7.15
Jewel (ck)	5.25	6.00	6.50	6.87	6.15
Jasper (ck)	5.25	4.50	5.12	6.12	5.25
Porto Rico (ck)	3.25	7.25	7.62	7.37	6.37
L0-323	6.87	6.62	7.25	7.12	6.96
L4-62	5.87	3.12	4.50	6.00	4.87
L4-112	6.37	6.00	6.75	7.12	6.56
L4-131	6.75	5.75	6.50	7.00	6.50
L5-5	4.00	5.25	5.12	6.37	5.18
L5-150	4.12	6.12	6.75	7.00	5.60
L5-36	6.62	5.12	5.25	5.62	5.65
L5-40	6.50	5.25	5.25	5.37	5.59
L5-42	5.87	6.25	6.75	5.87	6.18
L3-151	6.50	5.75	6.37	6.62	6.31
L3-186	4.62	6.62	6.50	6.25	5.60
L0-360	4.25	3.62	5.25	5.87	4.75
L5-6	5.75	5.37	5.25	5.25	5.40
L5-19	5.75	4.75	5.25	6.37	6.88
L5-51	5.37	4.75	4.00	4.50	4.65
LSD 0.05	0.68	0.53	0.71	ns	0.70

[a]Rating was from 0 to 10 with 10 representing maximum favorable expression of the character. Mean of two replications with eight raters per replication.

Table 35. Organoleptic ratings[a] of fleshy roots of sweet potato cultivars baked after 22 weeks in storage at 60°F (15.5°C) in the 1979 crop.

Cultivar	Color	Flavor	Texture	Fiber	Baking index
Centennial	3.2	5.3	5.4	6.4	5.07
Jewel	6.3	5.3	5.8	6.6	6.00
Jasper	6.0	4.6	5.5	6.2	5.57
Porto Rico	3.2	6.8	6.9	6.9	5.95
L0-323	7.1	4.7	5.4	6.3	5.87
L4-62	6.8	4.4	3.9	5.9	5.25
L4-112	7.6	4.8	4.6	6.0	5.75
L4-131	7.8	6.9	7.0	7.0	7.17
L5-5	5.9	5.7	5.6	6.5	5.92
L5-150	5.3	5.5	5.7	6.6	5.77
L5-36	6.8	4.3	4.4	5.7	5.30
LSD 0.05	.68	.44	.69	.31	.63

[a]Rating was from 0 to 10 with 10 representing the maximum favorable expression of the factor. Mean fo two replications with nine panel testers.

Table 36. Organoleptic ratings of fleshy roots of sweet potato cultivars baked after 22 weeks in storage at 70°F (21.1°C) in the 1979 crop.

Cultivar	Color	Flavor	Texture	Fiber	Baking index
Centennial	6.6	5.3	6.1	6.8	6.20
Jewel	6.0	5.6	6.3	6.4	6.07
Jasper	5.6	5.1	6.1	6.5	5.82
Porto Rico	3.2	5.7	6.3	6.1	5.32
L0-323	6.9	5.1	5.5	5.9	5.85
L4-62	5.5	3.4	4.4	6.1	4.85
L4-112	5.8	5.2	5.1	6.2	5.57
L4-131	6.8	6.8	6.8	6.7	6.77
L5-5	4.6	4.7	4.7	5.9	4.97
L5-150	5.6	6.3	7.0	7.1	6.50
L5-36	6.7	4.9	4.5	5.9	5.50
LSD 0.05	.86	.47	.60	ns	.63

[a]Rating was from 0 to 10 with 10 representing the maximum favorable expression of the factor. Mean of two replictions with nine panel testers.

Data in Figures 6 and 7 and Table 37 show the mean baking quality ratings as an average of 11 cultivars at the two temperature regimes in the 1978 test. The mean baking quality ratings for the cultivars stored at 60°F (15.5°C) were higher than those at 70°F (21.1°C). The mean baking index of all cultivars stored at 60°F (15.5°C) was 6.35 and at 70°F (21.1°C) it was 5.87. In the 1979 test no significant difference was observed between the mean baking index of the cultivars stored at 60°F (15.5°C) and those at 70°F (21.1°C) with baking indices of 5.78 and 5.76, respectively. Baking index is directly determined by the quality factors of color, flavor, texture and fiber content (12, 13, 105) and indirectly by the factors affecting the growing conditions of the sweet potato plants (15, 16). Constantin, Jones and Hernandez (15) reported that potassium fertilization increased fiber content. Increasing nitrogen fertilization was reported to reduce flesh color (14) and soil pH had a slight effct on fiber content (16).

Plant Production (1978-1979)

A comparison of 20 cultivars on total plant production from fleshy roots stored at 60°F (15.5°C) is shown in Table 38. 'Porto Rico', 'L4-112', 'Jewel' and 'L3-186' produced the largest number of total plants per bushel. However, 'Porto Rico' produced a significantly larger number than any other cultivar and 'Jewel' and 'L4-112' produced a comparable number. Several

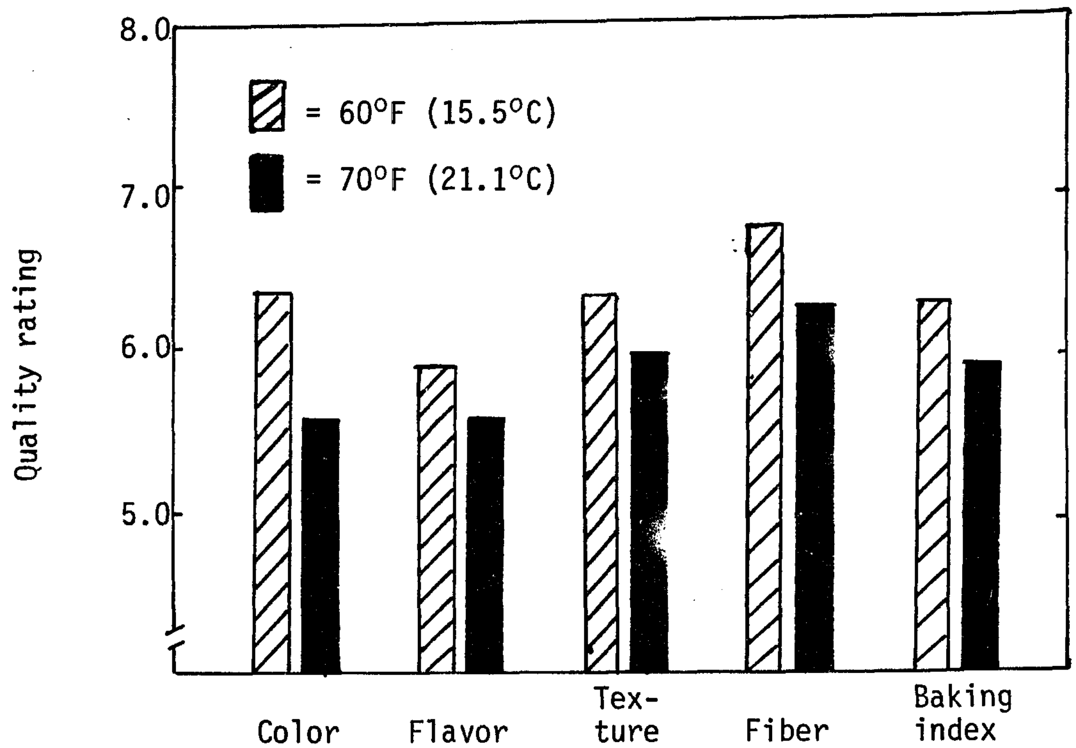


Figure 6. Organoleptic ratings of sweet potato fleshy roots baked after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 20 cultivars in the 1978 crop.

Table 37. A comparison of organoleptic ratings between storage temperatures for a mean of 20 cultivars in the 1978 crop, 11 cultivars in the 1979 crop and 11 cultivars in the mean of 1978 and 1979 crops.

Storage temperature	Color	Flavor	Texture	Fiber	Baking index
1978 crop:					
60 F (15.5 C)	6.34	5.90	6.31	6.73	6.35
70 F (21.1 C)	5.58	5.52	5.96	6.33	5.87
1979 crop:					
60 F (15.5 C)	6.00	5.25	5.47	6.37	5.78
70 F (21.1 C)	5.75	5.28	5.71	6.33	5.76
Mean of 1978 and 1979 crops:					
60 F (15.5 C)	6.17	5.57	5.89	6.55	6.05
70 F (21.1 C)	5.66	5.40	5.83	6.33	5.81

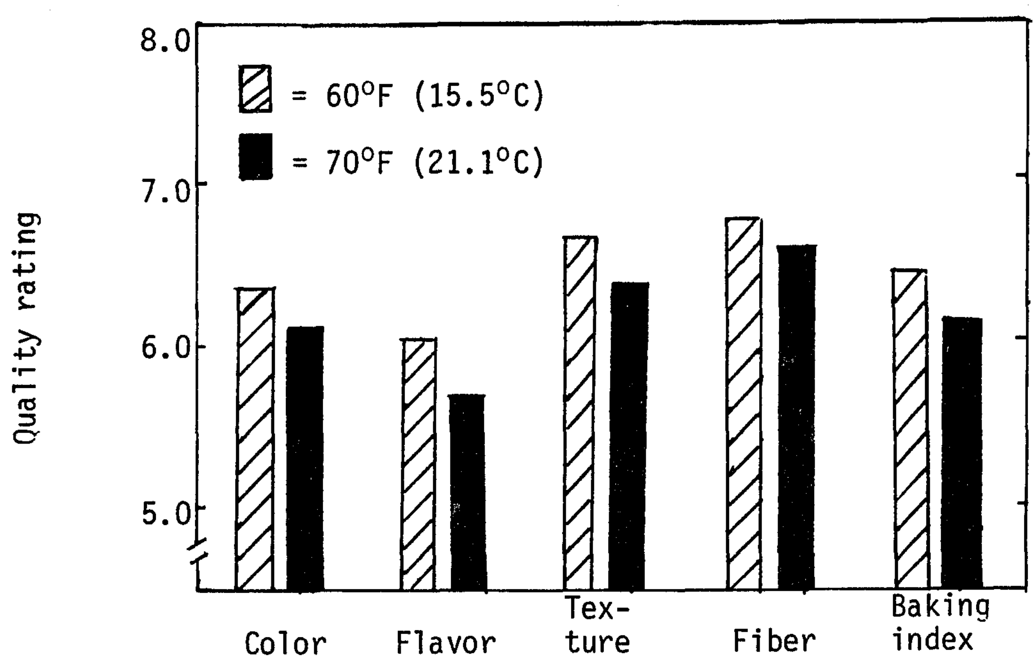


Figure 7. Organoleptic ratings of sweet potato fleshy roots baked after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) as an average of 11 cultivars in the 1979 crop.

cultivars were considered very poor plant producers as shown in Table 38 and would be questionable as major cultivars. There were 14 cultivars that produced fewer plants than 'Centennial' which had a total of 1,458 plants per bushel.

Data on plant production for the cultivars stored at 70°F (21.1°C) in 1978 are shown in Table 38. In general the fleshy roots of the cultivars stored at 70°F (21.1°C) produced an increase in plant number over the 60°F (15.5°C) storage. Several cultivars more than doubled the plant numbers in the 70°F (21.1°C) storage. 'Porto Rico' and 'L4-112' produced the largest number of plants as it did from the roots in the 60°F (15.5°C) storage. These data point out the significance that the storage temperatures have on plant production.

Data on plant production of roots of cultivars stored at 60°F (15.5°C) and 70°F (21.1°C) in the 1979 crop are shown in Table 39. The roots were bedded in a replicated test in field plots. Due to a late cool season and heavy rains the cultivars sprouted poorly in the Spring season of 1980. 'Porto Rico' was the only cultivar that produced an appreciable number of early plants having 270 early plants per bushel from the 60°F (15.5°C) storage. 'L4-112' was the second best with 85 early plants per bushel followed by 'Jewel' with 16 plants. For total plants produced from the 60°F (15.5°C) storage, 'Porto Rico' produced significantly the largest number of plants as in previous tests and it was followed by 'L4-112'.

Table 38. Plant production of fleshy roots of sweet potato cultivars stored at 60°F (15.5°C) and 70°F (21.1°C) in the 1978 crop[a].

Cultivar	60°F Early	60°F Late	60°F Total	70°F Early	70°F Late	70°F Total
	No. of plants per bushel					
Centennial	347	1111	1458	660	1384	2044
Jewel	254	672	926	624	1548	2172
Jasper	185	571	756	301	563	1620
Porto Rico	1191	2497	3688	1993	2411	4404
L0-323	128	797	925	237	650	887
L4-62	274	1346	1620	521	825	1346
L4-112	642	2279	2921	738	2931	3669
L4-131	44	601	645	325	1177	926
L5-5	12	183	195	4	141	144
L5-150	175	644	819	347	674	1021
L5-36	245	1010	1255	605	1430	2035
L540	124	667	791	892	1707	2599
L5-42	34	31	65	52	749	801
L3-151	189	1032	1221	794	2077	2871
L3-186	444	1674	2118	419	1914	2333
L0-360	56	233	289	335	1177	1512
L5-6	59	185	244	172	451	623
L5-19	19	72	91	444	1370	1814
L4-312	23	445	468	0	540	540
L5-51	122	668	1258	381	1094	1475
LSD 0.05	121	180	218	214	227	360

[a]Mean of four replications with ten roots per replication.

The cultivars stored at 70°F (21.1°C) all showed an increase in plant numbers over the 60°F (15.5°C) storage in early, late and total plant numbers as shown in Table 39.

A comparison in plant production of roots of cultivars as an average of two years stored at 60°F (15.5°C) and 70°F (21.1°C) is shown in Table 40. In general cultivar responses were similar to those described in Tables 38 and 39.

Previous workers (19, 29, 65, 86) have reported increasing plant production with higher temperature in storage. Slow plant producing cultivars have been induced to produce more plants by pre-heating (19, 29, 71).

In both 1978 and 1979 tests, roots stored at 70°F (21.1°C) as mean of cultivars had significantly higher number of sprouts than the roots stored at 60°F (15.5°C) (Table 41 and Figures 8 and 9).

Correlation Coefficients Between Characters as an Average of Cultivars

Using the mean values of the 20 cultivars for each of the characters measured in 1978, correlation coefficients between several characters were computed (Table 42). No significant correlation was found between yield (weight of total marketable roots) and the following: percent dry matter, weight loss, sprouting and baking qualities. It should be noted, that although the value is statistically not significant,

Table 39. Plant production of fleshy roots of sweet potato cultivars stored at 60°F (15.5°C) and 70°F (21.1°C) in the 1979 crop .

Cultivar	60°F (15.5°C)			70°F (21.1°C)		
	Early	Late	Total	Early	Late	Total
	Number of plants per bushel					
Centennial	0	381	381	283	341	624
Jewel	16	244	260	113	314	427
Jasper	7	69	76	211	261	472
Porto Rico	270	465	735	377	387	764
L0-323	8	75	83	67	314	381
L4-62	0	138	138	0	203	203
L4-112	85	582	677	342	657	999
L4-131	0	0	0	133	295	428
L5-5	0	54	54	21	194	215
L5-150	12	47	59	168	463	631
L5-36	0	6	6	54	412	466
LSD 0.05	98	104	111	114	110	112

[a]Mean of two replications with 20 roots each cultivar in a replication.

Table 40. Plant production of fleshy roots of sweet potato cultivars stored at 60°F (15.5°C) and 70°F (21.1°C) as an average of the 1978 and 1979 crops.

Cultivar	60°F (15.5°C) Early	60°F (15.5°C) Late	60°F (15.5°C) Total	70°F (21.1°C) Early	70°F (21.1°C) Late	70°F (21.1°C) Total
	No. of plants per bushel					
Centennial	173	746	919	471	862	1333
Jewel	135	458	593	368	931	1299
Jasper	96	320	416	256	412	668
Porto Rico	730	1481	2211	1185	1399	2584
LO-323	68	436	504	152	482	634
L4-62	137	742	879	260	514	774
L4-112	363	1430	1793	540	1794	2334
L4-131	22	300	322	229	736	965
L5-5	6	118	124	12	178	190
L5-150	87	345	432	257	568	825
L5-36	122	508	630	329	921	1250
LSD 0.05	91	117	168	108	143	174

Table 41. A comparison of plant production of sweet potato fleshy roots between storage temperatures of 60°F (15.5°C) and 70°F (21.1°C) for a mean of 20 cultivars in the 1978 crop, 11 cultivars in the 1979 crop and 11 cultivars in the mean of 1978 and 1979 crops .

Storage temperature	Early sprout	Late sprout	Total sprout
1978 crop:			
60°F (15.5°C)	228	836	1189
70°F (21.1°C)	492	1240	1815
1979 crop:			
60°F (15.5°C)	36	188	224
70°F (21.1°C)	160	349	510
Mean of 1978 and 1979 crop:			
60°F (15.5°C)	132	512	706
70°F (21.1°C)	326	236	1162

[a]Mean of 11 cultivars.

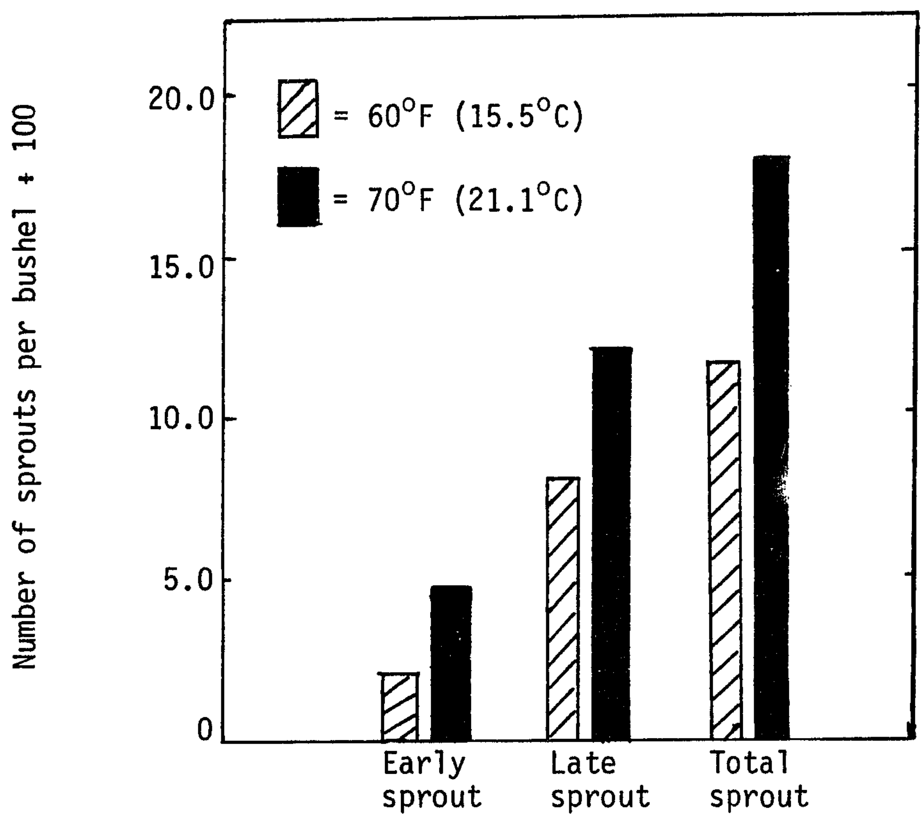


Figure 8. Plant production of sweet potato fleshy roots bedded after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) in the 1978 crop.

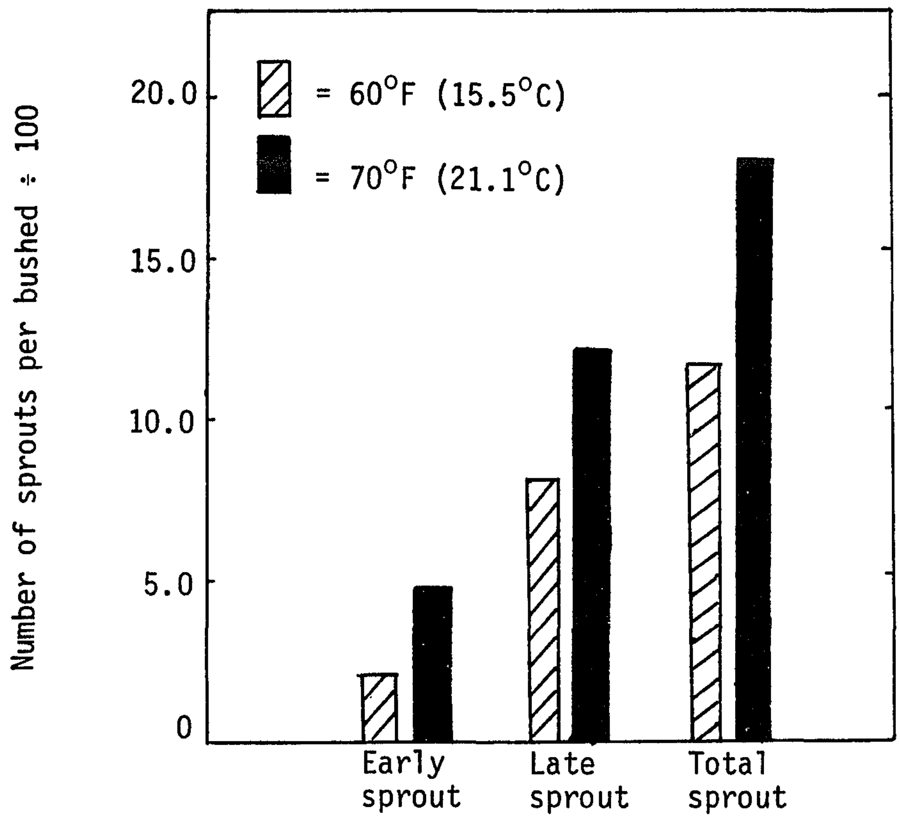


Figure 9. Plant production of sweet potato fleshy roots bedded after 22 weeks in storage at 60°F (15.5°C) and 70°F (21.1°C) in the 1979 crop.

the correlation coefficient between weight of total marketable roots and dry matter (-0.10), weight loss after storage at 60°F (-0.19) and at 70°F (-0.34) had negative signs. The total number of marketable roots was positively correlated with baking index (0.45) of roots previously stored at 70°F (21.1°C) and number of roots is important in the yield factor. Other characters were not significantly correlated with total number of marketable roots as shown in Table 42. Percent dry matter content at harvest was positively correlated with the following: flavor of baked roots stored at 60°F (15.5°C) and at 70°F (21.1°C), number of sprouts of roots stored at 60°F (15.5°C), flavor, texture and baking index of baked roots stored at 70°F (21.1°C). These correlations of dry matter content are all advantageous since the breeder would like to improve both the dry matter content and at the same time improve the baking qualities and the sprouting ability of roots after some months of storage.

In the 1979 test with 11 cultivars, the correlation coefficient between total root weight or percent dry matter at harvest and the other characters studied are summarized in Table 43. Total root weight was negatively correlated with percent dry matter at harvest (-0.45), with weight loss after five-month storage at 60°F (-0.43) and with most of the baking quality factors. This is not a desirable condition although high

Table 42. Correlations between characters in the 20 sweet potato cultivars of the 1978 crop[a].

Characters	Weight of total roots	No. of total roots	Percent dry matter
Percent dry matter	-0.10	0.12	---
Stored 60°F:			
Weight loss	-0.19	-0.06	-0.25
Baking quality:			
Color	0.16	0.11	0.08
Flavor	0.24	0.04	0.45*
Texture	0.14	-0.05	0.37
Fiber	0.32	0.15	0.12
Baking index	0.17	-0.01	0.24
Plant production	0.22	0.24	0.45*
Stored 70°F:			
Weight loss	-0.34	-0.25	-0.25
Baking quality:			
Color	0.36	0.43	-0.15
Flavor	0.04	0.10	0.75**
Texture	0.14	0.16	0.60**
Fiber	0.39	0.28	0.43
Baking index	0.38	0.45*	0.48*
Plant production	0.20	0.34	0.41

[a]Correlation coefficient estimated from mean of 20 cultivars for a sample size of 20.

*Significant at the 0.05 level

**Significant at the 0.01 level

Table 43. Correlations between characters in the sweet potato as an average of 11 cultivars in the 1979 crop[a].

Cultivars	Weight of total roots	No. of total roots	Percent dry matter
Percent dry matter	-0.45*	-0.03	---
Stored 60°F:			
Weight loss	-0.43*	-0.35	0.23
Baking quality:			
Color	-0.04	0.16	-0.51*
Flavor	-0.43*	-0.22	0.67**
Texture	-0.31	-0.24	0.61**
Fiber	-0.28	-0.26	0.59
Baking index	-0.42*	-0.21	0.63**
Plant production	0.11	0.47*	0.29
Stored 70°F:			
Weight loss	-0.27	-0.19	-0.13
Baking quality:			
Color	-0.11	-0.13	-0.36
Flavor	-0.64	-0.40	0.55**
Texture	-0.60**	-0.71**	0.42*
Fiber	-0.55*	-0.63**	0.20
Baking index	-0.48*	-0.39	0.35
Plant production	0.09	0.43*	0.31

[a]Correlation coefficients estimated from two replications in eleven cultivars for a sample size of 22.

*Significant at the 0.05 level.

**Significant at the 0.01 level.

yielding ability must not be minimized as it is of major importance. Percent dry matter at harvest was highly positively correlated with % dry matter after five-month storage at 60°F (15.5°C) and at 70°F (21.1°C) with values of 0.87 and 0.88, respectively. Percent dry matter was also positively correlated with flavor, texture, fiber and baking index of roots stored at 60°F (15.5°C) but negatively correlated with color of baked roots. The correlation coefficient between % dry matter and weight loss after storage at 70°F (21.1°C) and of color of baked roots were negative signs, -0.13 and -0.36, respectively, but they were not statistically significant. A significant positive correlation was obtained between % dry matter at harvest and flavor of baked roots (0.55) and texture of baked roots (0.42) stored at 70°F (21.1°C). As in the 1978 test, the associations of dry matter content with other characters under this study were desirable, that is, they were mostly positively correlated so that the expected improvement of dry matter is likely to produce improvemnts in these other characters.

Yamakawa and Sakamoto (110), working with genotypes adapted to true seed planting, found a highly significant negative phenotypic correlation between dry matter and yield in root weight per plant in their 1973 experiment. In their 1974 experiment they observed no significant phenotypic correlation but a highly significant positive genotypic correlation between dry matter and total root weight. Chew (7) using genotypes similar or derived from the same germplasm as the first study, also found negative correlation between dry matter and yield.

DISCUSSION

The polycross system of hybridization has become the primary method of breeding in the sweet potato (37). This has come about due to, at least, two reasons. First, hybridization using biparental crosses has been found by experience to be impractical for producing fairly large amounts of true seed because the sweet potato produces only, at most, four seeds per fruit and this is compounded by the occurrence of many self- and cross-incompatibilities (36, 38, 39, 99). The second reason is related to the fact that the sweet potato is normally a vegetatively propagated crop. A cross-pollinated species, the sweet potato is highly heterozygous and each and every individual plant in a polycross progeny is a unique recombinant genotype. The advantage in using the polycross system in sweet potato improvement is that each heterozygous seedling can be reproduced practically unchanged genetically through vegetative propagation.

The present research was aimed to generate quantitative genetic data for the sweet potato under a polycross system of mating. This research was particularly encouraged by the statement of Jones, Steinbauer, and Pope (57) to the effect that quantitative genetic theories, although formulated for use with diploids, may be applicable to the hexaploid sweet potato. They based their statements on previous cytological observations in the sweet potato showing bivalent pairing of the chromosomes during meiosis to be the rule and also on results from qualitative genetic studies indicating that many character segregations can be explained on the basis of multiple disomic models (57).

Quantitative genetic data, i.e. genetic variances, heritabilities, expected responses from selection, and others could be useful in, at least, two broad aspects of sweet potato breeding. First, they could serve as guides in making decisions about alternative selection strategies for genotypes to be entered or retained in a polycross nursery. Second, quantitative genetic data would be equally useful as a source of information in making decisions as to how much selection pressure should be exerted for a character at specific stages of the screening and testing process of segregating seedling progenies.

In the 1978 polycross progeny test, it was shown that there was considerable variability among individuals of the polycross seedling progeny of 'LO-323' in terms of total marketable root yield, skin color and flesh color of roots. Such large variability in these three characters could theoretically be attributed to both genetic and environmental causes, for as mentioned above, each and every individual plant in a polycross progeny of the highly heterozygous sweet potato is practically a unique genotype. This test, however, could not separate or partition the total phenotypic variance into their genetic and environmental components.

In the 1979 test, it was possible to partition the total phenotypic variance into the genetic and environmental components using a variance component analysis of half-sibs. The estimates of genetic variance, heritability, and expected response from selection for weight of US #1 roots and total marketable root yield were particularly encouraging, their heritabilities being close to 0.20. This data indicates that selection, especially in the form of culling the bottom genotypes, could be practiced effectively at the first harvest before field planting of the vegetatively propagated genotypes or seedlings. This has great significance since only a relatively few entries are saved by using the proper selection pressure, therefore, eliminating many undesirable genotypes.

Heritability estimates for some vine characters in this test were relatively high compared to the heritability estimates for most root traits. This partly agrees with the findings of Jones (51) although this test used a different population and a different method of analysis from that of Jones. A few of the findings in this test did not agree with Jones, i.e. this test showed that leaf vein color has very low heritability whereas Jones found very high heritability for this trait. This disagreement in the findings could be partly attributed to the difference in the make-up of the populations used. Jones (51) used a sample of various genotypes presumably including those closely related to wild ancestors. In this study, the population from which the sample was taken has been highly selected based on superior horticultural characters.

In the study of the correlation of various characters, it was shown that except for a few undesirable associations, which fortunately could be easily minimized with proper breeding and selection procedures, many of the correlations were positive indicating that improvement of one character would likely be accompanied by improvement of the other characters or at least no adverse effects were suggested. Among the few undesirable correlations, for instance, the negetive correlation coefficient between total fleshy root yield and root flesh color suggest the need to relax the selection pressure for fleshy roots at the first stage of the screening process in order that not many of the high yielding genotypes would be unknowingly discarded. Jones (53) stated that no adverse correlation was found in his studies between root weight and other characters.

In the advanced cultivar tests, the need was shown to test the cultivars in various locations or years. It was also shown that while there were cultivar X location interaction, in general, cultivars found high yielding in one location or year, such as 'L4-62' and 'LO-323', were also high yielders in the other locations or years. Depending on the objective of the breeder, cultivars should be developed to have very low cultivar X location or year interaction which is important for any cultivar. Cultivars developed which perform very well in one environment may not necessarily perform well in another, therefore, having a high cultivar X location or year interaction which, in general, is not desirable.

Weight loss of sweet potato roots in storage can only be minimized since sweet potatoes are living entities that continue to undergo metabolic reactions at lower rates when under appropriate storage conditions of 60°F (15.5°C) and 85% humidity following curing. The observation in the 1978 test shows that some cultivars, i.e. 'L5-5' and 'L5-36', performed just as well under 70°F (21.1°C) as under 60°F (15.5°C) storage. This indicates the possibility of developing cultivars that may not have high weight loss even under 70°F (21.1°C) storage which could therefore reduce energy use in storage rooms. Most of the present advanced cultivars show comparatively higher weight losses under 70°F (21.1°C) than under 60°F (15.5°C) but the encouraging thing is that most of them could be stored up to five month storage at 70°F (21.1°C).

All of the advanced seedlings have good organoleptic ratings and the difference between those stored at 60°F (15.5°C) and those stored at 70°F (21.1°C) were not large. This is again an encouraging finding since the storage of sweet potato roots under 70°F (21.1°C) was not very detrimental to the quality of the fleshy roots. Another interesting finding is that dry matter content at harvest was positively correlated with most of the quality factors especially the flavor and texture of baked roots. Breeders would like to develop cultivars that have a high dry matter at the same time having good quality.

Good sprouting in field bed is another important character that the breeders would like to see in a cultivar. The high yielding advanced seedlings in this test, i.e. 'L4-62' and 'LO-323' did not have very high sprouting ability but were considered at an acceptable level. 'L4-112' which did not produce a high yield but set the highest number of roots was the best plant producer among the advanced seedlings.

The positive correlations between dry matter content and flavor, texture and baking index of baked roots and plant production are some of the other interesting results in this study. No previous studies are shown in the literature for the relationship between these characters. Previous studies (12, 13, 28, 44, 45) on quality of baked roots have shown correlations between color, flavor, and other baking quality factors with baking index and a positive correlation was reported between flesh color and baking index.

The advanced cultivar 'L4-62', used in this study was subsequently released as a new variety in July 1980 and named 'Travis' in honor of the late Dr. Travis P. Hernandez, the second superintendent of the Sweet Potato Research Center, Chase, Louisiana, United States of America.

SUMMARY

To determine the genetic variance, heritabilities and correlations of yield, storage losses, plant production, and other root and vine characters in the sweet potato germplasm at LSU, two studies were conducted both in 1978 and 1979: polycross progeny tests, and comparison of advanced seedlings (cultivars).

In the 1978 polycross progeny test, it was found that among the 202 polycross seedling progeny of 'L0-323', 26.2% had copper root skin color and 15.6% rose skin which are the desirable skin colors and 40% were rated 4 (orange) and 5 (deep orange) in flesh color. These data were interpreted to reflect the progress that the LSU sweet potato breeding program has attained in the improvement of root skin and flesh color.

In the 1979 polycross progeny test, five maternal parents were studied: 'Centennial', 'L0-323', 'L9-163', 'L4-312' and 'L8-343'. Under normal selection procedures, 'L8-343' polycross seedling progeny had the highest percentage of selected seedlings on the basis of flesh color followed by the polycross seedling progeny of 'L9-163'. Estimates of heritability for root skin and flesh color were both very low. Root skin color was positively correlated with yield of US #1 roots and of total fleshy roots, vine length and vine diameter. A negative correlation was observed between root skin color and vine color. Root flesh color was

positively correlated with internode length and it was negatively correlated with yield of US #1 roots, total fleshy roots, plant production of bedded roots, vine diameter and number of seedling branches.

In yield of US #1 roots, 'L8-343' polycross progeny had the largest percentage of seedlings that did not produce any US #1 roots followed by 'L4-312' 'L9-163', 'L0-323' and 'Centennial'. In progeny mean yield, 'L0-323' produced the highest US #1 roots and 'L8-343' had the lowest. In total fleshy root yield, 'Centennial' had the highest progeny mean and 'L8-343' had the lowest.

The genetic variance expressed as a coefficient of variation was high both for yield of US #1 roots and of total fleshy roots with values of 51.5% and 38.9%, respectively. The estimates of heritability for yield of US #1 roots and of total fleshy roots were of sufficient magnitude indicating that selection could be practiced on an individual plant basis. Both the yield of US #1 roots and of total fleshy roots were positively correlated with vine length, vine diameter, internode length and number of branches. Yield of total fleshy roots was positively correlated with leaf shape and yield of US #1 roots was negatively correlated with vine color and leaf vein color.

The polycross seedling progeny mean for weight loss in storage was lowest for 'L9-163' and highest for 'L4-312'. Genetic variance component of weight loss in storage had a negative value. None of the correlation coefficients with other root and vine characters were significant.

The estimated genetic variance for plant production was very low, consequently, heritability was also very low. Plant production was negatively correlated with root flesh color. All other characters studied were not significantly correlated with plant production.

Estimates of genetic variance and heritability for number of US #1 roots and of total fleshy roots were of sufficient magnitude (0.202 and 0.290, respectively) therefore indicating that selection based on individual plant data is possible. Vine characters, i.e. vine length, vine diameter, young foliage color, leaf shape and petiole length had high estimates of genetic variances with heritability values of over 0.50. Vine color, internode length, number of branches and leaf vein color had lower than 0.21 heritability values.

Replicated yield tests for advanced seedlings in 1978 showed that 'L4-62' and 'L5-36' had comparable yield of US #1 roots with 'Centennial'. 'L0-323' also had comparable yield of total marketable roots with 'Centennial'. 'L4-112' and 'L5-40' had the highest yield of US #2 roots. 'L4-112', 'L5-36' and 'L4-62' had the largest number of total marketable roots per hill. Of the 11 cultivars tested in 1979, 'L0-323', L4-62' and 'L5-160' had the highest yield of US #1 roots which were comparable to yield of US #1 roots of 'Centennial', 'Jewel' and 'Jasper'. 'L0-323', 'L4-62' and 'L5-5' had significantly higher yields of Jumbo roots compared to the yield of 'Jasper'. The yield of total marketable roots for 'L0-323' and 'L4-62' were significantly higher than 'Centennial', 'Jewel', 'Jasper' and 'Porto Rico'. 'Centennial' had numerically the highest mean number of US #1 roots and total marketable roots per hill while 'L4-112' had numerically the highest mean number of US #2 roots per hill. There was a significant cultivar X location or year interaction in yield of US #1 roots and total marketable roots and in mean number of total marketable roots per hill.

In a two year study in dry matter content of fleshy roots, it was found that 'Porto Rico' had the highest dry matter content at harvest (27, 77) and in subsequent storage temperatures. Among the advanced seedlings, 'L3-186' and 'L4-131' had the highest dry matter content and 'L4-62' had the lowest.

Percentage weight loss in storage varied among cultivars and between temperature regimes. At the end of 20 weeks storage at 60°F (15.5°C) in 1978, 'L5-150', 'L4-131' and 'L5-5' showed the least weight loss and 'L5-6', 'L5-42' and 'L4-312' had the highest. At 70°F (21.1°C), 'L5-36' had the least weight loss and 'L4-312' had the highest. As an average of 20 cultivars, weight loss of roots stored at 60°F (15.5°C) was lower than the weight loss of roots stored at 70°F (21.1°C). When weight loss was plotted against time of storage at both temperatures, there was a fast rate of increase in weight loss from end of curing to four weeks in storage, then a slower rate from four weeks to eight weeks and again a fast rate.

Organoleptic ratings for baked roots in the 1978 tests showed that 'LO-323', 'L4-112' and 'L4-131' had comparable baking indices at 60°F (15.5°C) and at 70°F (21.1°C). Generally, all the cultivars were considered acceptable in quality factors in the 1978 and 1979 tests.

In the 1978 test, 'Porto Rico', 'L4-112', 'Jewel' and 'L3-186' produced the largest number of total plants per bushel from roots stored at 60°F (15.5°C). Many of the 20 cultivars tested were considered poor plant producers. Roots stored at 70°F (21.1°C) for all cultivars produced an increase in plant number over the 60°F (15.5°C) storage. In 1979, poor plant production was obtained from all cultivars at both storage temperatures and 'Porto Rico' and 'L4-112' produced the most plants.

Dry matter content in 1978 was positively correlated with flavor, plant production of roots stored at 60°F (15.5°C) and with flavor, texture and baking index of roots stored at 70°F (21.1°C). In the 1979 crop, weight of total marketable roots was negatively correlated with dry matter content, weight loss in storage, flavor and baking index of roots stored at 60°F (15.5°C), texture, fiber and baking index of roots stored at 70°F (21.1°C). The mean number of total roots per hill was positively correlated with plant production of roots at both storage temperatures and negatively correlated with texture and flavor of baked roots stored at 70°F (21.1°C). Dry matter content was negatively correlated with color of baked roots stored at 60°F (15.5°C) but positively correlated with flavor, texture, and baking index of roots stored at 60°F(15.5°C) and with flavor and texture of roots stored at 70°F (21.1°C).

BIBLIOGRAPHY

1. Allard, R. W. 1960. Principles of plant breeding. John Wiley and Sons, New York. J. VII.+ 485 pp.

2. Anon. 1979. National sweet potato variety trial, Clemson University-Edisto Experiment Station, Blacksville, South Carolina. In: National Sweet Potato Collaborators Group Progress Report, 1978. (H. L. Hammett, compiler). Published at LSU and A&M, Baton Rouge, Louisiana. pp. 58-61.

3. Anon. 1979. Sprout and seedpiece propagation report. In: National Sweet Potato Collaborators Group Progress Report, 1978. (H. L. Hammett, compiler). Published at LSU and A&M, Baton Rouge, Louisiana. p. 78.

4. Becker, W. A. 1967. Manual of procedures in quantitative genetics (2nd ed.). Published by the Program in Genetics, Washington State University. 107 pp.

5. Boudreaux, J. E. and L. G. Jones. 1978. Field plot studies with sweet potatoes. J. Amer. Soc. Hort. Sci. 103(1):87-89.

6. Burton, G. W. and E. H. Devane. 1953. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. Agron. J. 45:478-481.

7. Chew, S. T. 1977. A study of high soil mixture levels and water submergence on the sweet potato (Ipomoea batatas (L.) Lam.). Ph.D. Dissertation. Louisiana State University, Baton Rouge, Louisiana. 153 pp.

8. ________. 1978. Wet soil stress effects on sweet potatoes. J. Amer. Soc. Hort. Sci. 103(5):600-603.

9. Cockerham, C. C. 1963. Estimation of genetic variance. In: Statistical Genetics and Plant Breeding. (W. D. Hanson and H. F. Robinson, eds.) Publication No. 982. National Academy of Sciences. National Research Council, Washington D.C. pp. 53-95.

10. Collins, W. W. 1977. Diallel analyses of sweet potatoes for resistance to *Fusarium* wilt. J. Amer. Soc. Hort. Sci. 102(2):109-111.

11. Comstock, R. E. and H. F. Robinson. 1948. The components of genetic variance in populations of biparental progenies and their use in estimating the average degree of dominance. Biometrics. 4:254-266.

12. Constantin, R. J. 1964. A study of the inheritance of several characters in the sweet potato, Ipomoea batatas. Ph.D. Dissertation. Louisiana State University, Baton Rouge, Louisiana. 82 pp.

13. ________, Teme P. Hernandez, J. C. Miller and H. L. Hammett. 1966. Inheritance of baking quality in the sweet potato Ipomoea batatas. Proc. Amer. Soc. Hort. Sci. 88:498-500.

14. ________, ________ and L. G. Jones. 1974. Effects of irrigation and nitrogen fertilization on quality of sweet potatoes. J. Amer. Soc. Hort. Sci. 99:308-310.

15. ________, L. G. Jones, and Teme P. Hernandez. 1977. Effects of potassium and phosphorus fertilization on quality of sweet potatoes. J. Amer. Soc. Hort. Sci. 102:779-781.

16. ________, ________ and ________. 1975. Sweet potato quality as affected by soil reaction (pH) and fertilization. J. Amer. Soc. Hort. Sci. 100:604-607.

17. Cooley, J. S. and L. J. Kushman. 1947. Effects of storage temperature on the sprouting of four varieties of sweet potatoes. Proc. Amer. Soc. Hort. Sci. 50:311-313.

18. Dempsey, A. H., L. J. Kushman, and J. E. Love. 1970. Storage. In: Thirty Years of Cooperative Sweet Potato Research, 1939-1969. (Teme P. Hernandez, coordinating ed.) Southern Cooperative Series Bulletin No. 159. pp. 36-38.

19. Deonier, M. T. and L. J. Kushman. 1960. The effect of pre-sprouting and type of bed on the early production of sweet potato plants. Proc. Amer. Soc. Hort. Sci. 75:557-560.

20. Dudley, J. W. and R. H. Moll. 1969. Interpretation and use of estimates of heritability and genetic variance in plant breeding. Crop Sci. 9:257-261.

21. Duncan, A. A., L. E. Scott, and F. C. Stark. 1958. Effect of potassium chloride and potassium sulfate on yield and quality of sweet potatoes. Proc. Amer. Soc. Hort. Sci. 71:391-397.

22. Edmond, J. B. 1971. Genetics, breeding behaviour, and development of superior varieties. In: Sweet Potatoes: Production, Processing, Marketing. (J. B. Edmond and G. R. Ammerman, eds.) AVI Publishing Co., Inc., Westport, Connecticut. pp. 58-80.

23. Falconer, D. S. 1976. Introduction to quantitative genetics (8th printing). Ronald Press Co., New York. 365 pp.

24. Godfrey-San-Aggrey, W. and H. S. Bundu. 1971. Growing sweet potato for tubers and leaves. Njala, the University College, University of Sierra Leone. Dept. of Agron. Circular No. 2. 6 pp.

25. Granberry, D. M., R. A. Conover, and B. T. Whatley. 1977. Storage root production of sweet potato seedlings and vegetative progeny. HortSci. 12:62-63.

26. Hahn, S. K. 1977. A quantitative approach to source potentials and sink capacities among reciprocal grafts of sweet potato varieties. Crop Sci. 17:559-562.

27. ________. 1977. Sweet potato. In: Ecophysiology of Tropical Crops. (P. T. Alvin and T. T. Kozlowski, eds.) Academic Press, Inc., New York. pp. 237-248.

28. Hammett, H. L. 1965. A study of the inheritance of root shape, skin color, total carotenoid pigments, dry matter, fiber and baking quality in the sweet potato (Ipomoea batatas). Ph.D. Dissertation, Louisiana State University, Baton Rouge, Louisiana. 129 pp.

29. ________. 1979. Some factors affecting sprout production in sweet potatoes. HortSci. 14:428.

30. ________, R. C. Albritton and F. T. Withers. 1978. Hardcore in some sweet potato cultivars and lines. J. Amer. Soc. Hort. Sci. 103:239-241.

31. Hanson, W. D. 1963. Heritability. In: Statistical Genetics and Plant Breeding. (W. D. Hanson and H. F. Robinson, eds.) Publication No. 982. National Academy of Sciences. National Research Council, Washington D.C. pp. 125-140.

32. Harmon, S. A., H. L. Hammett, Teme P. Hernandez and D. T. Pope. 1970. Progress in the breeding and development of new varieties. In: Thirty Years of Cooperative Sweet Potato Research, 1939-1969. (T. P. Hernandez, Coordinating editor.) Southern Cooperative Series Bulletin No. 159. pp. 8-17.

33. Haynes, P. 1970. Some general and reigonal problems of sweet potato (Ipomoea batatas (L.) Lam.) growing. In: Proc. 2nd Intl. Symp. Tropical Root and Tuber Crops. (D. L. Plucknett, ed.), Honolulu, Hawaii. Vol. I. pp. 10-13.

34. Hasselbring, H. and L. A. Hawkins. 1915. Physiological changes in sweet potatoes during storage. Jour. Agr. Res. 3:331-341.

35. Hernandez, Teme P. 1942. A study of some genetic characters of the sweet potato. M.S. Thesis. Louisiana State University, Baton Rouge, Louisiana. 33 pp.

36. ________. 1979. Genetic improvement of the sweet potato, Ipomoea batatas, L. A paper presented at a conference at IITA, Ibadan, Nigeria. October 15-19, 1979.

37. ________. 1979. Unpublished paper, Department of Horticulture, Louisiana State University, Baton Rouge, Louisiana.

38. ________ and J. C. Miller. 1959. Self- and cross-incompatibility in some sweet potato varieties and seedlings. Proc. Amer. Soc. Hort. Sci. 81:428-433.

39. ________ and ________. 1964. Further studies of incompatibility in the sweet potato. Proc. Amer. Soc. Hort. Sci. 85:426-429.

40. ________, ________ and J. F. Fontenot. 1950. Studies of plant production of sweet potatoes including the effects of chemical treatments. Proc. Amer. Soc. Hort. Sci. 55:423-426.

41. ________, ________ and Travis P. Hernandez. 1956. Mutation: a means of improving sweet potato varieties and seedlings. Proc. Assn. S. Agr. Workers 53rd Annual Conv. p. 175

42. ________, R. J. Constantin, and H. L. Hammett. 1978. Breeding and testing sweet potatoes in 1978. In: Annual Report of Horticulture Research Projects. Department of Horticulture, Louisiana State University, Baton Rouge, Louisiana. pp. 65-79.

43. ________, H. L. Hammett, R. J. Constantin, C. Clark, L. Rolston and L. G. Jones. 1979. Breeding and testing of sweet potatoes in 1978. In: National Sweet Potato Collaborators Group Progress Report. (H. L. Hammett, compiler.) Louisiana State University. pp. 35-38.

44. ________, Travis P. Hernandez, R. J. Constantin and J. C. Miller. 1965. Inheritance of and method of rating flesh color in Ipomoea batatas. Proc. Amer. Soc. Hort. Sci. 87:387-390.

45. ________, ________, ________ and R. S. Kakar. 1969. Improved techniques in breeding and inheritance of some of the characters in the sweet potato, Ipomoea batatas (L.). In: Proc. Intl. Symp. Tropical Root Crops. St. Augustine, Trinidad, April 2-8, 1967. (E. A. Tai, W. B. Charles, P. H. Haynes et al., eds.) Vol. I. pp. 31-40.

46. Hernandez, Travis P. 1963. A study of skin color, total carotenoid pigments, dry matter and techniques in classifying the characters in Ipomoea batatas. Ph.D. Dissertation, Louisiana State University, Baton Rouge, Louisiana. 91 pp.

47. Hsi, D. C. H. 1979. National sweet potato variety trial in New Mexico State University Agricultural Experiment Station. In: National Sweet Potato Collaborators Group Progress Report, 1978. (H. L. Hammett, compiler.) Louisiana State University, Baton Rouge, Louisiana. pp. 47-50.

48. Jones, A. 1965. A proposed breeding procedure for sweet potato. Crop Sci. 5:192-193.

49. ________. 1966. Morphological variability in early generation of a randomly intermating population of sweet potatoes (Ipomoea batatas (L.) Lam.) Univ. of Georgia Agric. Expt. Station Bulletin N.S. 56 pp. 1-31.

50. ________. 1967. Theoretical segregation ratios qualitatively inherited characters for hexaploid sweet potato. ARS, USDA Technical Bulletin No. 1368. 43 pp.

51. ________. 1969. Quantitative inheritance of ten vine traits in sweet potatoes. Proc. Amer. Soc. Hort. Sci. 94:408-411.

52. ________. 1970. Phenotypic, genotypic and environmental correlations in sweet potatoes. J. Amer. Soc. Hort. Sci. 95:326-330.

53. ________. 1977. Heritabilities of seven sweet potato root traits. J. Amer. Soc. Hort. Sci. 10:440-442.

54. ________ and P. D. Dukes. 1976. Some seed, seedling, and maternal characters as estimate of commercial performance in sweet potato breeding. J. Amer. Soc. Hort. Sci. 101:385-388.

55. ________, ________ and F. P. Cuthbert, Jr. 1976. Mass selection in sweet potato. J. Amer. Soc. Hort. Sci. 101:701-704.

56. ________, M. G. Hamilton and P. D. Dukes. 1978. Heritability estimates for fiber content, root weight, shape, cracking, and sprouting in sweet potato. J. Amer. Soc. Hort. Sci. 103:374-376.

57. ________, C. E. Steinbauer and D. T. Pope. 1969. Quantitative inheritance of ten root traits in sweet potatoes. J. Amer. Soc. Hort. Sci. 94:271-275.

58. Jinks, J. L. 1964. Extrachromosomal inheritance. Prentice-Hall, Inc., Englewood-Cliffs, New Jersey. XIV + 177 pp.

59. Jong, S. 1974. A genotype X season interaction and heritability in sweet potato, Ipomoea batatas (L.) Lam. selections experiments. Ibadan, IITA. (Mimeo.) 10 pp.

60. ________. 1974. Study of the sequential characteristics of sweet potato populations. Ibadan, IITA, Nigeria. (Mimeo.) 14 pp.

61. ________ and K. Y. Park. 1975. Variety X environmental interaction in sweet potato, Ipomoea batatas (L.) Lam. tests in Korea. Research Report of the Office of Rural Development, Korea, Suweon. 17 (C):125-130

62. Kim, J. Y. 1977. The growth and development of storage roots of three sweet potato (Ipomoea batatas) cultivars. M.S. Thesis. Department of Horticulture, Mississippi State University, Starksville, Mississippi. 77 pp.

63. Kimber, A. J. 1970. Some cultivation techniques affecting yield response in the sweet potato. In: Proc. 2nd Intl. Symp. Tropical Root and Tuber Crops, Aug. 23-30, 1970, Honolulu, Hawaii. (D. L. Plucknett, ed.) University of Hawaii. Vol. I. pp. 32-36.

64. Knight, R. L. 1948. Dictionary of genetics. Chronica Botanica Co., Waltham, Massachussetts.

65. Kushman, L. J. and M. T. Deonier. 1957. Effects of storage temperature on Porto Rico, Allgold, and Goldrush sweet potatoes. Proc. Amer. Soc. Hort. Sci. 70:425-431.

66. ________ and ________. 1958. Effects of weather, date of harvest and curing treatments on keeping qualities of Porto Rico sweet potatoes. Proc. Amer. Soc. Hort. Sci. 71:369-375.

67. ________ and ________. 1959. Relation of gas content and respiration to keeping quality of Porto Rico sweet potatoes. Proc. Amer. Soc. Hort. Sci. 74:622-641.

68. ________, ________, J. M. Lutz, and B. Walters. 1954. Effects of temperature and soil moisture at harvest and of delay of curing on keeping quality of Porto Rico sweet potatoes. Proc. Amer. Soc. Hort. Sci. 63:415-419.

69. ________ and D. T. Pope. 1970. Changes in pH and total acidity of sweet potatoes exposed to wet, cold soil conditions before harvest. HortSci. 5:510-511.

70. ________, ________ and R. J. Monroe. 1966. Estimation of intercellular space and specific gravity of five varieties of sweet potatoes. North Carolina Agric. Expt. Sta. Bull. No. 175. 14 pp.

71. ________, W. O. Drinkwater, and B. Graves. 1970. Plant production. In: Thirty Years of Cooperative Sweet Potato Research, 1939-1969. (Teme P. Hernandez, coordinating ed.) Southern Cooperative Series Bulletin No. 159. pp. 18-24.

72. Li, Liang. 1965. Studies on association among yield components and their relationship to tuber yield in sweet potatoes. J. Agric. Assn. China. (New Series) No. XXXXIX, March 1965. pp. 1-14.

73. ________. 1975. Studies on the inheritance of quantitative characters in a randomly intermating population of sweet potatoes (Ipomoea batatas (L.) Lam.) J. Agr. Res. China (Formerly: J. Taiwan Agr. Res.) 24(3/4). Abstract. In: Sweet potato: abstracts of selected research and development literature, 1949-1979. (G. O. Ibekwe, compiler.) IITA, Ibadan, Nigeria, No. 119. p. 53.

74. Lowe, S. B. and L. A. Wilson. 1975. Yield and yield components of six sweet potato (Ipomoea batatas) cultivars. II. Variability and possible sources of variation. Experimental Agric. 11:49-58.

75. Lutz, J. M. 1952. Influence of temperature and length of curing period on keeping quality of Porto Rico sweet potatoes. Proc. Amer. Soc. Hort. Sci. 59:421-425.

76. Martin, F. W. 1970. The sterility-incompatibility complex of the sweet potato. In: Proc. Intl. Symp. Tropical Rootcrops. University of West Indies. April 2-8, 1967. Vol. I pp. 3-15.

77. Mather, K. and J. L. Jinks. 1971. Biometrical genetics: the study of continuous variation. Cornell Univ. Press, Ithaca, New York. XII + 382 pp.

78. McCombs, C. L. and D. T. Pope. 1958. The effect of length of cure and storage temperature upon certain quality factors of sweet potatoes. Proc. Amer. Soc. Hort. Sci. 72:426-434.

79. Miller, J. C. 1930. A study of mutations of the Porto Rico sweet potato. Proc. Amer. Soc. Hort. Sci. 27:343-346.

80. ________. 1937. Inducing the sweet potato to bloom and set seed. J. Heredity. 28:347-349.

81. ________. 1939. Further studies and technic used in sweet potato breeding in Louisiana. J. Heredity. 30:485-492.

82. ________ and Teme P. Hernandez. 1970. The sweet potato as a world food crop and how research has improved its nutritional quality. Proc. 2nd Intl. Symp. Tropical Root and Tuber Crops. (D. L. Plucknett, ed.) Honolulu, Hawaii. Vol. I. pp. 16-18.

83. Norman, C. W. and T. M. Little. 1966. Effects of heating and cutting roots on sweet potato sprout production. Proc. Amer. Soc. Hort. Sci. 88:477-480.

84. Perkins, J. M. and J. L. Jenkins. 1968. Environmental and genotype-environmental components of variability. III. Multiple lines and crosses. Heredity. 23:339-356.

85. ________ and ________. 1968. Environmental and genotype-environmental components of variability. IV. Non-linear interaction for multiple inbred lines. Heredity. 23:525-535.

86. Phills, B. R. 1972. Effect of ethephon temperature, water submergence, and cultivars on sweet potato plant production. M.S. Thesis. Louisiana State University, Baton Rouge, Louisiana. 73 pp.

87. Plaisted, R. L. and L. C. Peterson. 1959. A technique for evaluating the ability of selections to yield consistently in different locations or seasons. Am. Potato J. 36:381-385.

88. Poole, C. F. 1952. Seedling improvement in sweet potato. Hawaii Agr. Expt. Sta. Bull. No. 17. 16 pp.

89. Pope, D. T. 1970. Recent progress and current needs of the sweet potato industry in the United States. In: Proc. 2nd Intl. Symp. Tropical Root and Tuber Crops. (D. L. Plucknett, ed.) Honolulu, Hawaii pp. 7-10.

90. Purcell, A. E., W. M. Walter, Jr., and F. G. Giesbrecht. 1978. Changes in dry matter, protein and non-protein nitrogen during storage of sweet potato. J. Amer. Soc. Hort. Sci. 103:190-192.

91. Roberts, D. D., W. E. Kronstad, and A. Haunold. 1980. Genetic variability and association of maturity, yield, and quality characteristics of female hops. Crop Sci. 20:523-527.

92. Robinson, P. 1963. Heritability: A second look. In: Statistical Genetics and Plant Breeding. (W. D. Hanson and H. F. Robinson, eds.) Publication No. 982. National Academy of Sciences. National Research Council, Washington D.C. pp. 609-612.

93. Saladaga, F. A. 1975. Status of research and research need for rootcrops in Central and Eastern Visayas. A paper presented at First Agric. System Research Congress for Central and Eastern Visayas, Cebu City, Philippines. November, 1975. Sponsored by the Philippine Council for Agriculture and Resources Research--the Visayas State College of Agriculture and the National Economic Development Authority. pp. 1-4.

94. ________. 1976. Post-harvest physiology of rootcrops. VISCA Review. Vol. I (2nd quarter.) pp. 1-3.

95. ________. 1976. Collection and evaluation of rootcrop varieties. VISCA Review. Vol. I (4th Quarter.) pp. 7-9.

96. Scossiroli, R. 1963. Discussion on the paper of P. Robinson. In: Statistical Genetics and Plant Breeding. (W. D. Hanson and H. F. Robinson, eds.) Publication No. 982. National Academy of Sciences--National Research Council, Washington D.C. p. 613.

97. ________, A Ferrari and G. Haussman. 1963. Genetic variability for quantitative characters in alfalfa. In: Statistical Genetics and Plant Breeding. (W. D. Hanson and H. F. Robinson, eds.) Publication No. 982. National Academy of Sciences--National Research Council, Washington D.C. pp. 597-608.

98. Tesreskovich, G. and D. W. Newsom. 1965. Some effects of date of washing and grading on keeping quality of sweet potatoes. Proc. Amer. Soc. Hort. Sci. 86:538-541.

99. Thibodeaux, S. P. 1972. Combining ability and other factors affecting sweet potato breeding. Ph.D. Dissertation. Louisiana State University, Baton Rouge, Louisiana. 81 pp.

100. Thompson, P. C., F. L. Haynes and R. H. Moll. 1980. Estimation of genetic variance components and heritability for tuber dormancy in diploid potatoes. Am. Potato J. 57:39-46.

101. Turner, J. L., H. Bryce and M. H. Hollingsworth. 1979. Sweet potato investigation at Auburn University Agricultural Experiment Station. In: National Sweet Potato Collaborators Progress Report, 1978. (H. L. Hammett, compiler.) Louisiana State University, Baton Rouge, Louisiana. pp. 7-12.

102. Villareal, R. L. and S. C. Tsuo. 1979. Sweet potato tips as vegetables. HortSci. 14(3):469.

103. ________, ________, S. K. Lin and S. C. Chiu. 1979. Use of sweet potato (Ipomoea batatas) leaf tips as vegetables. II. Evaluation of yield and nutritive quality. Experimental Agric. 15(2):117-122.

104. ________, ________, S. C. Chiu, and S. H. Lai. 1979. Use of sweet potato (Ipomoea batatas) leaf tips as vegetables. III. Organoleptic evaluation. Experimental Abric. 15(2):123-127.

105. ________, ________, S. H. Lai, and S. H. Chiu. 1979. Selection criteria for eating quality in steamed sweet potatoes. J. Amer. Soc. Hort. Sci. 104:31-33.

106. ________, S. K. Lin, L. S. Chang and S. H. Lai. 1979. Use of sweet potato (Ipomoea batatas) leaf tips as vegetables. I. Evaluation of morphological traits. Experimental Agric. 15(2):113-116.

107. Wang, Hsia. 1975. The breeding and cultivation of sweet potatoes. Technical Bulletin No. 26. ASPAC Food and Fertilizer Technology Center, Taipei City, Taiwan. 41 pp.

108. Wilson, L. A. 1970. The process of tuberization in sweet potato (Ipomoea batatas). In: Proc. 2nd Intl. Symp. Tropical Root and Tuber Crops. (D. L. Plucknett, ed.) University of Hawaii, Honolulu, Hawaii. Vol. I. pp. 24-26.

109. Wright, S. 1921. Systems of mating. I, II, III, IV, V. Genetics. 6:111-178.

110. Yamakawa, O. and S. Sakamoto. 1980. Studies on breeding sweet potato varieties adapted to true seed planting. I. Flowering habit, seed-setting and adaptibility of natural flowering population to true seed planting. Japan J. Breed. 30(2):151-160. (English tables; English summary on p. 159.)

AUTOBIOGRAPHY

The author is the second child of Mr. and Mrs. Cecilio and Rosario Saladaga of Tabogon, Cebu--a populous island province at a central location of the 7,100 islands comprising the Philippines. He obtained his elementary education as First Honorable Mention in his hometown, and attended high school at the Visayas Agricultural College (VAC, now the Visayas State College of Agriculture or VISCA), Baybay, Leyte. Consistently elected President of his class from his freshman to his junior year in high school, he was also elected Vice-President of the High School Student Body Organization in his junior year, and President of the Future Farmers of the Philippines (FFP VAC Chapter) and Secretary of the FFP Eastern Visayas District Association in his senior year. In 1965, he graduated Valedictorian in his class and was cited by the VAC Faculty as the Outstanding Student Leader of the Year.

Eager to study, he tried his luck with only a meager allowance at the University of the Philippines at Los Banos College (UPLB), Laguna, about 37 miles from Manila where he was fortunate indeed to be awarded the Tapia Scholarship-Study Grant in his freshman year, a U. P. Undergraduate Fellowship in his sophomore year, and finally a CASELF scholarship in his junior and senior years. Honorifically awarded at one time as University Scholar and at other times as College Scholar for maintaining high grade point averages, he was also awarded a Medal for Duty by the Commandant of the UPLB-ROTC Unit in 1967. Elected for two terms as President of the UPCA Men's Dormitory Residents Association, he was also elected President of The Symposium, a voluntary student organization at UPLB.

Immediately after graduation in 1969, he was appointed U. P. Teaching Fellow at the Department of Agricultural Botany, UPLB where he taught courses in General Botany and Plant Physiology while taking courses leading to an M.S. degree. Granted a scholarship by the National Science Development Board, he obtained his M.S. degree major in Agricultural Botany (Plant Physiology) and minor in Soil Science in 1973.

He was fortunate to have had experiences working with the National Pollution Control Commission (NPCC) as a project leader in the studies on effects of pollution on plants and later with the International Rice Research Institute (IRRI) first as Research Assistant and then as Senior Research Assistant working with studies on the efficiency of fertilizer and pesticide application in flooded rice. Appointed by VISCA President Bernardo and the Board of Trustees as Assistant Professor III and Chairman of the Department of Plant Breeding and Botany in 1975, he taught courses in General Botany while working as study leader in the "Collection and evaluation of rootcrop varieties". He was the Leader of the Task Force that defined the status of research and research needs for rootcrops and vegetables during the First Regional Agricultural System Research Congress for the Central and Eastern Visayas Regions, Skyview Hotel, Cebu City, November, 1975. In 1977, he was elected associate member of the National Research Council of the Philippines (NRCP).

Married to the former Miss Fe Baclayon Saavedra, the daughter of Mr. and Mrs. Vicente and Maria Clara Saavedra, they are lucky to have a fine young boy, Daniel and a sweet little girl Lorelei.

Awarded a scholarship by the International Development Research Center (IDRC), Ottawa, Ontario, Canada, he was granted a special detail by the Philippine Government to pursue a Ph.D. degree in Horticulture (Plant Breeding) at Louisiana State University, Baton Rouge, Louisiana, United States of America, and is now a candidate for the degree.

EXAMINATION AND THESIS REPORT

Candidate: Florencio Ando Saladaga

Major Field: Horticulture

Title of Thesis: Genetic variance, heritability and correlation for genetic characters of the sweet potato, Ipomoea batatas, L.

Approved:

Teme P Hernandez

Major Professor and Chairman

James P. Traynham

Dean of the Graduate School

EXAMINING COMMITTEE:

Donald W Newsom

M. T. Henderson

R. J. Constantin

W. L. [illegible]

James F. Fontenot

Date of Examination:

November 21, 1980